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EFFECTS OF WATER POLLUTION IN SAN
FRANCISCO BAY

Gene E. Willeke

Stanford University
Stanford, California

October 1968

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WP-01194-01

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EFFECTS OF WATER POLLUTION IN SAN FRANCISCO BAY

by
GENE E. WILLEKE

This research was supported by grant WP-01194-01
from the Federal Water Pollution
Control Administration

Report EEP-29
October 1968

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164

UNITED STATES GOVERNMENT

Memorandum

U. S. DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
760 MARKET STREET
San Francisco, California 94102

TO : Regional Directors (8)
(See Below)

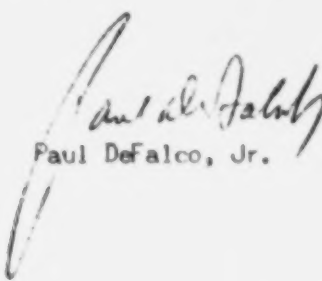
DATE: December 4, 1968

FROM : Director, Pacific Southwest Region

SUBJECT: Report on Effects of Water Pollution in San Francisco Bay

The attached report "Effects of Water Pollution in San Francisco Bay" is an excellent example of an attempt to relate the social sciences and public attitudes to problems of water pollution. Its author, Gene Willeke is a former engineer with our agency.

This report presents a fresh new approach to the evaluation of water pollution problems and I highly recommend it for your reading and serious consideration.



Paul DeFalco, Jr.

Attachment

Northeast Region
Middle Atlantic Region
Southeast Region
✓ Ohio Basin Region
Great Lakes Region
Missouri Basin Region
South Central Region
Northwest Region

EFFECTS OF WATER POLLUTION
IN SAN FRANCISCO BAY

By
Gene E. Willeke

PROJECT ON ENGINEERING-ECONOMIC PLANNING
STANFORD UNIVERSITY
STANFORD, CALIFORNIA

Report EEP-29
October 1968

This report was originally prepared as a copyrighted dissertation submitted to the Department of Civil Engineering and the Committee on the Graduate Division of Stanford University in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

ACKNOWLEDGMENTS

Of the many persons who contributed in one way or another to the research reported in this thesis, several made particular contributions that I wish to acknowledge.

The impetus to study the interfaces between civil engineering and the social sciences came, in large part, from my wife, Carol. She has also been an important critic when necessary.

Professor Ray K. Linsley further encouraged this probing into the social sciences and suggested the consideration of survey research as a principal tool. His comments have always been helpful.

Of the several social scientists who influenced this study, Professors William J. Paisley and Wilbur Schramm have certainly been among the most helpful.

Mr. Aaron Levy and Miss Joie Hubbert of Field Research Corporation had both the insight to grasp the nature of my research effort and the professional competence to carry through the field work, with the help of a good staff and good interviewers, in a remarkable way.

For guidance in the intricacies and details of computer programming and use, I am indebted to Mr. John Arrington and Dr. Ray Funkhouser.

Mr. James McCarty was very helpful in problem definition and in providing background on San Francisco Bay.

Thanks are due to a friendly critic, Mr. James W. Meek, who could often understand concepts I could not yet communicate in words.

For funding, I am grateful for the support of the Federal Water Pollution Control Administration (Grant WP-01194-01).

For assistance in typing, I am grateful to Miss Carol Streit, Mrs. Barbara Miner, and Mrs. Beatrice Sanders.

Finally, I am very grateful to the 914 persons whose names I do not know but whose freely given responses are reported and analyzed in the following pages. Their contribution has been a public service that will perhaps recompense them for giving a portion of their time and their thought to answer what may have appeared to be unimportant questions.

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I. INTRODUCTION

BACKGROUND

In recent years, water pollution control has become an increasingly important focal point of water resources management in the United States. This has occurred for a variety of reasons, including the decreasing quality of our water resources in key localities, the increased desire and capacity to use these resources--particularly for recreational purposes--and the fact that often an aroused public has demanded cleaner water.

In meeting these demands for cleaner water, water quality control investigators frequently are confronted with the question of what, precisely, are the effects of polluted water on recreational activities. The question can be further elaborated and the following list of more specific questions is not untypical:

- a. Are people being affected by polluted water at the present time? If so, how many people are affected and in what ways?
- b. What are the relationships, if any, among water quality levels and degrees of impairment for recreational use?
- c. Given a present situation of recreational use impairment by low quality water, what changes in water quality would effect increased recreational use of a water body?
- d. What actions, other than improving water quality, could be taken to bring about increased recreational use of a water body?
- e. Can the effects of water pollution on recreational activities be quantified, so that these effects can be compared with

the costs of improving water quality?

This is only a partial list, but it poses important questions that require the attention of both the private and public sectors of society. The questions have a larger significance in that very similar questions are being asked in other areas of engineering, including air pollution, transportation, urban development, housing and solid waste disposal.

This list of questions provides a framework for the objectives of the research program. The methods of study are in large part those of the social sciences. The research effort is not, however, an attempt to advance the social sciences; rather, it is an engineering study, an attempt to use the social sciences--theory and method--to aid in the solution of an important problem.

Several decades ago, health and esthetics were the primary reasons for water quality control. Concerns about health were directed toward drinking supplies. The concern with esthetics was framed in terms of "common decency" (Public Health Activities Committee, pp. 75-76). Stream and lake conditions were often vile, an evaluation with which both conservationist and industrialist alike might have agreed, although their judgments about what should be done, if anything, may have been widely divergent.

Occasionally, other issues such as fish kills, the discharge of highly toxic substances into water, and prolific algæ growths have also been targets of pollution control efforts.

Considerable progress has been made over the years in quality control. The safety of drinking water supplies is no longer considered a problem. To all intents and purposes, it has been solved, primarily

by the treatment of raw water before distribution and secondarily by the treatment of municipal and industrial wastes before discharge into receiving waters. With exceptions, the requirements of "common decency" have generally been met. Despite these achievements, quality control efforts have increased, rather than decreased, and are, at present, concerned with problems more closely related to improving the quality of the environment. Suitability of water for recreational activities and higher esthetic standards have taken the place of the old justifications for quality control programs. The shift to higher standards of water quality has been accompanied by decision problems that are in many ways more difficult than those of several decades ago (Fair, Geyer, and Okun, 1966).

Domestic and industrial wastes receive many kinds and levels of treatment. Considering the case of municipal sewage, at least five kinds of treatment can be identified in current practice: 1) Primary treatment, involving settling and/or screening, is the lowest level of treatment. Settleable solids are removed and a portion of the biochemical oxygen demand (BOD) is removed. 2) Beyond primary treatment, the usual step is secondary biological treatment. Secondary biological treatment removes a much higher percentage of BOD, nearly all the settleable solids, and a substantial percentage of pathogenic micro-organisms. 3) Disinfection may be used after primary or secondary biological treatment with the particular intent of destroying or reducing the population of pathogenic micro-organisms. 4) Tertiary treatment processes have received little use until recent years and their use is not widespread. These processes include filtration,

oxidation, and chemical treatment. They are used for further removal of pathogens, BOD, nutrients, and other materials. 5) Chemical treatment is sometimes used after primary treatment to effect a degree of treatment intermediate between primary and secondary biological treatment.

In cases where oxygen considerations are of most importance, the decision to use a higher level of treatment than is presently being given may not be difficult. Low oxygen levels in receiving waters are accompanied by a number of undesirable conditions that both cause economic loss and offend "common decency". If oxygen considerations are not of great importance, it is much more difficult to decide that a higher level of treatment than is presently being given should be applied to domestic sewage. If challenged to identify those water uses affected by existing levels of water quality and to indicate the magnitude of abuse effects, it is difficult or impossible to produce such evidence.

Recreational use of San Francisco Bay is a prime example. Recent quality reports on San Pablo Bay, Northern and Central San Francisco Bay show that dissolved oxygen levels are relatively high (7-9 mg/l) and that dissolved oxygen is not considered a major problem in these parts of the Bay (Storrs, et al., 1964). There are no defensible bacterial standards that can be used to show that recreational use of the Bay need be inhibited by high bacteria counts (Public Health Activities Committee, 1964, pp. 68-69). Yet, the higher levels of sewage treatment being asked for by regulatory authorities are those whose major effects are to reduce BOD, bacteria counts, and a

heterogeneous group of additional substances. Chlorination or other disinfection practices that were initiated by the East Bay Municipal Utility District and the City of San Francisco at its S. F. Plant in 1966 (State Policy, 1967, p. 1-8) are entirely concerned with bacterial reduction. It may properly be asked whether the quality standards being promulgated and considered by regulatory authorities are justified and whether the expenditures for additional treatment facilities are likely to be accompanied by the enhancement of the general welfare; in particular, the enhancement of recreational activity and esthetic enjoyment of San Francisco Bay.

It would be desirable, if possible, to express the answer to this question in terms of monetary values that could be directly compared with the costs of constructing treatment facilities and other quality control measures. Because the water uses most likely to be affected are recreational and esthetic in character, difficulty would be expected in achieving this goal. (It is not suggested that economic evaluation of the magnitude of these effects is impossible, although such an evaluation was not attempted in the present investigation.)

The anticipated difficulty of measurement in monetary terms stems in part from the fact that standards of esthetic judgment vary among individuals. An important factor is the standard of comparison, which might be a mental picture of another body of water--the Pacific Ocean, Lake Tahoe, Clear Lake, etc.--or a formal set of quality standards. In addition to varying standards of judgment, individuals have varying perceptions of their environment. Water considered "clean" by one individual might be considered "dirty" or "polluted" by others.

Although judgments are important in perception, the amount of information and the way it has been selected, organized and interpreted are more important (Berelson and Steiner, 1964, p. 88).

OBJECTIVES

To proceed with the investigation of the ways in which water pollution as perceived by people living in the Bay Area affects recreational behavior and personal habits, a more specific list of objectives was formulated in terms of the following questions:

1. What attitudes and opinions do Bay Area adults have about the present quality of Bay water and about the effects this water could have on a person?
2. What sources are used in acquiring information about the Bay, what sources are credible, and what sources are considered to have a responsibility for informing the public about the Bay?
3. How many persons refrain from participation in recreational activities on San Francisco Bay because of their perception of some aspect of water quality?
4. How much confidence do persons have in the ability of society and technology to cope with Bay pollution?
5. Is pollution of San Francisco Bay an issue of importance to the Bay Area public?
6. What are the implications for policies and programs of the findings of this investigation?

RESEARCH PLAN AND METHODOLOGY

Collecting information on individual perceptions and judgment standards of San Francisco Bay requires direct contact with individuals. To obtain this information, a survey of a representative sample of adults was conducted in the nine Bay Area counties during September-October, 1967.

The respondents were selected in a four-stage process. In the first stage, the geographic study area was divided or stratified into three parts:

- a. North Bay--Marin, Solano, Napa, and Sonoma counties;
- b. East Bay--Contra Costa and Alameda counties; and
- c. Peninsula--San Francisco, San Mateo, and Santa Clara counties.

In the second stage, key addresses for each of the three regions were selected from telephone directories by a systematic random procedure.

The third stage was conducted in the field, and consisted of the selection of clusters of five households, including the household at the key address, by a systematic procedure.

The final stage was the selection of a person within the household. This determination was made in the field by the interviewer on a quota basis. In each cluster of five households, not less than two nor more than three, men could be included. Further details of sample selection and research administration are given in Appendix A.

The final sample consisted of 914 respondents, with 204 cases in the North Bay, 326 cases in the East Bay, and 384 cases on the

Peninsula. These proportions were approximately those desired. The North Bay and East Bay samples are larger relative to the Peninsula sample than would be indicated by the respective populations of these areas. Disproportionate sampling was used to ensure a sufficiently large sample in each of the areas to make possible better interpretation of contingency tables for each of the areas, if desired.

The sample was determined to be representative of the population of the Bay Area on the basis of demographic comparisons with the 1960 U.S. Census. With allowances for trends since 1960, the sample has similar distributions of ethnic groups, education, household income, and age. Details are given in Appendix C.

The questionnaire, included in Appendix A, is the operationalization of the research objectives. Every effort was made in its construction to deal with possible threats to validity. The questionnaire was pretested in two stages. Question 36 was pretested alone and the complete questionnaire was pretested on a different sample.

GENERAL NOTES

The total sample was a stratified sample. The probability of a household being included in the sample was not proportionate to the population of the region. Because of this fact, the tabulations in the text often have an N other than 914. Many of the tables have an N of 763 or 765. These two figures are approximately equal to the maximum subsample of the total sample that can be obtained while maintaining the probability of a household being included in the sample proportionate to the population of the subregion.

The sample of 763 or 765 was divided into random halves for some analyses, so that conclusions based on one sample could be checked on the other. Therefore, an N of about half this number appears in some of the analyses.

Where the text says a figure or set of figures is based on the total sample, an N of 914 should be assumed, if it is not explicitly mentioned.

Unless otherwise specified, an asterisk, "*", as a table entry signified a percentage less than 0.5 percent.

Explanatory footnotes are placed at the end of the chapter in which they appear. Literature references are at the end of the report.

All chi-square tests are tests of the hypothesis of no relationship between the variables.

II. VARYING PERCEPTIONS OF SAN FRANCISCO BAY

APPEALING AND UNAPPEALING ASPECTS OF THE BAY

The first insights into public attitudes toward the Bay come from Questions 4 and 5 at the beginning of the questionnaire. These questions ask, in turn; "What are the most appealing things to you about the San Francisco Bay itself?" and "What are the most unappealing things about the Bay?"

Responses were categorized into six relevant groups. The categories and the percent of responses falling in each category for the full sample are shown in Table II-1. Table II-2 gives typical examples

TABLE II-1. APPEALING AND UNAPPEALING ASPECTS OF
SAN FRANCISCO BAY.

	<u>Appealing</u>	<u>Unappealing</u>
Water Pollution	0%	51%
View	73	8
Water Characteristics (General)	23	10
Recreation Opportunities	13	5
Climate	9	6
Commercial Factors	5	8
Nothing in Particular	8	28
Irrelevant Responses	3	4

N = 914

TABLE II-2. TYPICAL CATEGORY CODING EXAMPLES, APPEALING AND UNAPPEALING ASPECTS OF SAN FRANCISCO BAY.

VIEW

Appealing

Like to look at the Bay
Like to see the skyline
Lights
Ships
Boats
Scenery
Seagulls
Specific spots on the Bay

Unappealing

Too cluttered with buildings
Unesthetic
Skyline destroys view
Not good to look at
Signs
Cars too close to Bay
Tract houses
Signs

WATER CHARACTERISTICS (GENERAL)

Appealing

Color of water
Beauty of water
Variety of water
Clean looking
Sparkling
Peaceful
Relaxing
Calming
Like smell
Salt water

Unappealing

Salt flats
Swamps
Mud flats
Water too shallow
Too cold
Too rough

RECREATION OPPORTUNITIES

Appealing

Water skiing
Fishing
Boating
Sailing
Beaches

Unappealing

Not good for water skiing,
fishing, swimming, sailing
Beaches inaccessible
Beaches unmanaged
Need more recreation areas

CLIMATE

Appealing

Cooling effect
Fog
Fresh air
Temperate weather

Unappealing

Fog
Smog
Humidity
Dampness
Windy

TABLE II-2--Continued

COMMERCIAL FACTORS

Appealing

Good for shipping
Economic privileges
Travel
Bridges mean fast travel
Harbors
Fishing industry (commercial)

Unappealing

Port facilities antiquated
Industries dirty looking
Shoreline too industrialized
Too much traffic
Freeways near Bay

NON-BAY ANSWERS

Appealing

Golden Gate Park
Skyways
Freeways
Chinatown
Zoo

Unappealing

Don't like Bay area
Specific non-Bay features of
Bay area
Husband jumped from Golden
Gate Bridge

WATER POLLUTION

Unappealing

Refuse
Debris
Dirty water
Garbage
Filling
Oil on water
Murky
Stagnant
Odor
Dumps
Wastes
Kills fish
Dirty beaches

of responses coded in each category. These responses were not entirely confined to the Bay itself, but included the land in the Bay area and its cities. There can probably be no clear line of division between public perception of the Bay and of the surrounding region.

People in the nine-county Bay area are, in general, favorably disposed toward San Francisco Bay. They more often cite things they like, than dislike, about the Bay, as shown in Table II-1. More than one-fourth of the respondents found nothing in particular unappealing about the Bay, compared with 8 percent who found nothing in particular appealing about the Bay.

There is a diversity of reaction to the Bay. Almost as many people dislike the climate as like it. Twenty-three percent like the characteristics of the water, while 10 percent dislike them. Five percent like the commercial aspects of the Bay; 8 percent dislike them. Almost three-fourths of the people like the view; 8 percent dislike it. Thirteen percent find the recreation opportunities appealing; 5 percent do not. Such a diversity is to be expected although, a priori, one could not have predicted the percentages.

Over half of the people cite water pollution as an unappealing aspect of the Bay. Later in the questionnaire, 50 percent of the respondents said they thought the Bay was polluted. They are not all the same persons who gave a response coded as water pollution in the former question (Table II-3). Twenty-three percent of those who

TABLE II-3. UNAPPEALING ASPECTS OF BAY vs. EVALUATION OF
BAY WATER QUALITY.

	Unappealing Aspects of Bay		
	Pollution	All Other	Total
Bay is Polluted	61%	40%	51%
Don't Know, Not Sure	23	39	31
Bay is Not Polluted	16	21	18
Total	100%	100%	100%
Number of Cases	397	366	763

N = 763, Chi-square = 34.9, 2 degrees of freedom, .001 level of significance.

mentioned something coded as pollution in the former question did not know for sure in the latter question whether the Bay was polluted and 16 percent said that it was not, while 40 percent of those who did not mention pollution in the former question did believe that it was polluted when asked about it later. This comparison indicates that the concept of pollution probably differs somewhat in the two questions.

There is a high degree of regional uniformity in response to the questions on likes and dislikes. The only major difference is that in the East Bay, 16 percent of the respondents dislike some water characteristic, compared with 8 percent and 7 percent in the Peninsula and North Bay, respectively.

Annual family income was the only demographic variable significantly related to the citing of pollution as an unappealing feature of the Bay (Table II-4). Persons from households in the lowest income

TABLE II-4. HOUSEHOLD INCOME vs. UNAPPEALING ASPECTS OF THE BAY.

Unappealing Aspects of Bay	Under \$5,000	\$5,000- 7,499	\$7,500- 9,999	\$10,000- 14,999	Over \$14,999	Refused	Total
Pollution	28%	43%	52%	46%	48%	33%	42%
All Other	72	57	48	54	52	67	58
Total	100%	100%	100%	100%	100%	100%	100%
Number of Cases	162	131	141	180	88	61	763

N = 763, Chi-square = 22.1, 5 degrees of freedom, .001 level of significance.

group (less than \$5,000) mentioned pollution less frequently than did those in all higher income groups. The group that refused to give their income was more like the lowest income group than the others, for this question.

General satisfaction with the Bay Area is coupled with an apparent desire to improve it. Question 36, part 11, states "The Bay Area is a wonderful place to live and should stay just as it is." Thirty-seven percent of the respondents agreed or strongly agreed with this item, and forty-two percent disagreed or strongly disagreed, with twenty-one percent undecided. This item provides less information than would be desirable because it asks first whether the Bay Area is a wonderful place to live (with which one might agree, despite undesirable features) and, second, whether the Bay Area should stay just as it is (with which one might disagree on many grounds despite liking the Area as a place to live in comparison with other places).

The responses to the above item, considered together with Question 5 (unappealing aspects of the Bay) take on added significance. A negative response to Question 36, part 11, probably should be interpreted to mean that people generally do like the Bay Area but would not like it to stay just as it is. The nature of desired changes is not apparent, however, 50 percent of those who mentioned pollution as an unappealing aspect of the Bay, disagreed that the Bay Area should stay as it is, compared with 35 percent of those mentioning other unappealing aspects (Table II-5). This would indicate that pollution is one of the factors about the Bay Area that people would like to have changed.

TABLE II-5. UNAPPEALING ASPECTS OF THE BAY vs. EVALUATION OF THE BAY AREA AS A PLACE TO LIVE.

The Bay Area is a wonderful place to live and should stay just as it is	<u>Unappealing Aspects of Bay</u>		
	Pollution	All Other	Total
Strongly Agree	11%	15%	13%
Agree	22	27	24
Undecided	17	26	21
Disagree	41	28	35
Strongly Disagree	9	5	7
Total	100%	100%	100%
Number of Cases	470	444	914

N = 914, Chi-square = 28.1, 4 degrees of freedom, .001 level of significance.

PERCEPTION OF BAY WATER QUALITY

Terminology

The concept of pollution, as applied to San Francisco Bay in this survey, has meanings that differ somewhat from question to question. Most of the variation results from the meaning of the concept to the respondent in the context of the questions rather than to definitions used in the coding process. All the meanings are similar, but the differences are sufficiently important to merit consideration in the interpretation of survey results. If this is not done there are a few inexplicable anomalies.

Table II-6 gives examples of the responses to particular questions

TABLE II-6. TERMS CODED AS POLLUTION.

	<u>Terms</u>
Unappealing Aspects of the Bay (Question 5)	refuse; debris; dirty water; garbage; filling; oil on water; murky; stagnant; odor; dumps; wastes; kills fish; dirty beaches
Major Recreational Activities (Questions 7, 8, 10, 11, 13, 14, 16, 17)	polluted; dirty; garbage or debris floating on water; scum; unsanitary; makes you sick
Would you eat fish caught in the Bay? (Question 18b)	fish unsafe; undesirable; polluted because they've been in Bay water; wouldn't eat if knew; fish have oily taste; bad odor; garbage or sewage in Bay; fish aren't clean or healthy; would eat if assured of safety

(questionnaire is in Appendix A) that were coded as water pollution.

Unappealing aspects of the Bay (Question 5) and the group of questions on major recreational activities (7, 8, 10, 11, 13, 14, 15, 16, and 17) are most similar in coding. For these questions, any response concerning an aspect of water quality other than temperature was coded as pollution. Question 18b, "Would you eat fish caught in the Bay?", used the same approach but this question was limited to fish and the responses considered relevant from a pollution standpoint were somewhat different as can be seen from the table.

In all other cases, the meaning of pollution must necessarily be different, because the word is used as a stimulus to which the interviewee responds. The response depends entirely upon the interviewee's

conception of the term, and varies, therefore, from person to person.

The varying meanings of the term pollution necessarily imply that a certain amount of irreducible error will be present in some of the interpretations. An example has already been given (Table II-3). Of those persons who cited pollution as an unappealing aspect of the Bay, 16 percent said later in the questionnaire that the Bay was not polluted now, and 23 percent either did not know or were not sure whether the Bay was polluted. Unless one makes the unlikely assumption that the opinions of this many persons have changed radically in the course of the interview, one must necessarily assume that there are differences in meaning or perception.

Question 24, "How do you think someone could tell whether the Bay were polluted or not?", provides information on what the respondent considers pollution. Visual evidence or odors were mentioned by about 79 percent, and scientific analysis by 27 percent, of the respondents. The terms used by the respondents in describing the signs of pollution are similar to those used in the coding of the questions listed in Table II-6: debris; garbage; dead fish, birds, and animals; oil; foam on water; filth; odor; dirty, murky, scummy water; muddy; slimy; etc.

Quality control agencies normally characterize pollution primarily by a formal set of chemical, biological, or physical measurements, such as dissolved oxygen, BOD, suspended solids, nitrogen, phosphorus, bacteria counts, etc., rather than by visual and odor criteria.

The value of a formal set of quality requirements is beyond question as a basis for evaluating quality trends and issuing quality control orders. Agreement on these requirements by the parties

concerned provides a mechanism for compliance (social pressure, supplemented by the possibility for legal action).

A disadvantage of most formal characterizations of pollution is that they may have little relationship to pollution as perceived by the public. Formally "clean" water may be considered "polluted" and vice versa by the public, leaving recreational activities virtually unbenefitted by the standards.

Evaluation of Present Condition of the Bay

Of the 50 percent of the respondents who thought the Bay was polluted, 25 percent rated the Bay extremely polluted, 55 percent rated it somewhat polluted, and the remainder rated it only slightly polluted. These figures indicate the extent of the variation in perception of Bay water quality. The variation should have an important influence on quality control planning and implementation, particularly in obtaining public support for quality control measures. These problems are considered in Chapter IV.

Appraisals of Bay water quality could not readily be made from the evaluations given by the respondents in this survey. As an assessment of Bay quality, the scale of severity of pollution is at best ordinal, with the three categories representing low, medium, and high quality. It may not meet the practical requirements of an ordinal scale and certainly does not meet formal requirements because of varying definitions, a problem that could not really be solved without a uniform standard of comparison. However, these personal evaluations are very influential on decisions about personal use of the Bay, because it is

the characterization of a condition by a person that influences his action. It is quite immaterial whether the Bay is crystal clear, bacteria free, and odorless, or murky, odorous, and filled with bacteria, except as these features are influential in forming the characterization of the Bay.

The Public Health Activities Committee of the American Society of Civil Engineers (1963, p. 67) cites evidence that bathers do not always perceive water to be hazardous, even in the presence of quarantine signs and guards to enforce the quarantine. If a person believes the Bay is extremely polluted, his activities or lack of them on the Bay are influenced by this belief rather than by the actual state of the water (actual state being a perception of the water through the eyes or instruments of someone else). This would be a trivial observation if it were not for the fact that opinions about the relative degree of pollution of the Bay will be seen to be one of the best predictors of whether a person's recreation activities have been affected by perception of Bay pollution.

Perception of Bay water quality is most closely related to the information variables. It is no surprise that perception should depend upon information. The degree of association between perception of Bay water quality and the particular measures of information in this study provide strong confirmation of the relationship (Table II-7). Persons who have heard the Bay is polluted are much more likely, than are those who have not, to believe that the Bay is polluted. The table shows that information is not the only factor shaping perceptions of Bay quality. One-third of the persons who had heard the Bay is polluted

TABLE II-7. INFORMATION ABOUT BAY POLLUTION vs. EVALUATION OF BAY WATER QUALITY.

	Heard Bay is Polluted	Don't Know, Not Sure	Never Heard Bay is Polluted	Total
Bay is Polluted	66%	32%	20%	50%
Don't Know, Not Sure	24	50	43	32
Bay is Not Polluted	10	18	37	18
Total	100%	100%	100%	100%
Number of Cases	502	34	227	763

N = 763, Chi-square = 157.4, 4 degrees of freedom, .001 level of significance.

either were not sure or did not think it was polluted now.

The relationship between evaluation of Bay water quality and Question 27a, "Have you heard anything recently about Bay pollution or Bay fill?", is not as strong but is still significant (Table II-8). Persons who have recently heard something about Bay pollution or Bay fill are more likely to believe the Bay is polluted.

There is a strong association between the evaluation of Bay water quality and Question 29, "How much have you heard about Bay pollution or Bay fill?" (Table II-9). The more a person has heard about Bay pollution or Bay fill, the more likely he is to say the Bay is polluted.

The internal consistency between the questions "Have you ever heard that San Francisco Bay is polluted?" and "How much have you heard about

TABLE II-8. RECENT INFORMATION ABOUT BAY POLLUTION OR FILL vs.
EVALUATION OF BAY WATER QUALITY.

	Heard Recently	Haven't Heard Recently	Total
Bay is Polluted	60%	38%	50%
Don't Know, Not Sure	26	38	32
Bay is Not Polluted	14	24	18
Total	100%	100%	100%
Number of Cases	462	301	763

N = 763, Chi-square = 35.6, 2 degrees of freedom, .001 level of
significance.

TABLE II-9. AMOUNT HEARD ABOUT BAY POLLUTION OR FILL vs. EVALUATION
OF BAY WATER QUALITY.

	Amount Heard				
	Great Deal	Somewhat	Not Much	Hardly Any	Total
Bay is Polluted	84%	65%	41%	22%	50%
Don't Know, Not Sure	11	24	33	50	32
Bay is Not Polluted	5	11	25	28	18
Total	100%	100%	100%	100%	100%
Number of Cases	132	238	198	195	763

N = 763, Chi-square = 151.7, 6 degrees of freedom, .001 level of
significance.

Bay pollution or Bay fill?" is shown in Table II-10. If Question 26a,

TABLE II-10. AMOUNT HEARD ABOUT BAY POLLUTION OR FILL vs.
INFORMATION ABOUT BAY POLLUTION.

	Amount Heard				Total
	Great Deal	Somewhat	Not Much	Hardly Any	
Heard Bay is Polluted	90%	84%	65%	28%	66%
Don't Know, Not Sure	2	1	6	9	4
Never Heard Bay is Polluted	8	15	29	63	30
Total	100%	100%	100%	100%	100%
Number of Cases	132	238	198	195	763

N = 763, Chi-square = 194.6, 6 degrees of freedom, .001 level of significance.

"Do you think the Bay is polluted?", is dichotomized into "Yes" and "Not yes", either of these information variables used as predictors predicts correctly in over 70 percent of the cases. Thus, the value of these two questions as predictors is apparent. If the trichotomy is maintained in Question 26a, each predicts almost 60 percent of the cases correctly.

Of the demographic variables, only sex is significantly associated with a belief that the Bay is polluted (Table II-11). Males more frequently say that the Bay is polluted than do females, but the real difference is that a higher percentage of females do not know or are

TABLE II-11. SEX vs. EVALUATION OF BAY WATER QUALITY.

	<u>Male</u>	<u>Female</u>	<u>Total</u>
Bay is Polluted	56%	47%	50%
Don't Know, Not Sure	24	37	32
Bay is Not Polluted	20	16	18
Total	100%	100%	100%
Number of Cases	382	381	763

N = 763, Chi-square = 16.4, 2 degrees of freedom, .001 level of significance.

sure. Because males have higher rates of participation in recreational activities on the Bay (Table II-12), it might be suggested that the issue is more relevant to males than to females.

TABLE II-12. SEX vs. PARTICIPATION IN RECREATIONAL ACTIVITIES ON THE BAY.

	<u>Male</u>	<u>Female</u>	<u>Total</u>
Boating or Sailing on Bay	41%	24%	32%
Swimming on Bay	17	9	13
Water Skiing on Bay	3	1	2
Fishing on Bay	34%	12%	22%
Number of Cases	177	197	374

A multivariate discriminant analysis was performed to determine the combination of predictors that best discriminate between persons who believe the Bay is polluted and those who do not. Demographic, information, credibility, and Bay recreational use variables were used in the predictor set (Table II-13). Two of the information variables--

TABLE II-13. PREDICTOR SET FOR EVALUATION OF BAY WATER QUALITY.

A. Demographic Variables

Age
Education
Income
Sex
Ethnic Group
Length of residence in Bay Area

B. Information Variables

How much have you heard about Bay pollution or Bay fill?
Have you ever heard the Bay is polluted?
Have you heard anything recently about Bay pollution or fill?
Have you received enough information about Bay pollution or fill?

C. Contact with Bay

Frequency of seeing Bay
Have you ever gone boating or sailing on the Bay?
Have you ever gone swimming on the Bay?
Have you ever gone water skiing on the Bay?
Have you ever gone fishing on the Bay?

D. Credibility Variables

Credibility of federal government
Credibility of state government
Credibility of local government
Credibility of newspaper editorials or articles
Credibility of television documentaries
Credibility of private conservation organizations
Credibility of scientific experts
Credibility of close friends

"Have you ever heard the Bay is polluted?" and "How much have you heard about Bay pollution or Bay fill?"--discriminate between the two groups as well as the full predictor set. It is interesting to note that the discriminant functions developed for one random half of the 765-case subsample actually correctly assigned a higher proportion of cases for the other random half though the differences are not great. The overall accuracy of group assignment was 71 percent. For persons who thought the Bay was polluted, the average accuracy was 80 percent and for persons who did not think the Bay was polluted, 62 percent.

The nature of the discriminant function is such that persons who have heard the Bay is polluted and who have heard more about Bay pollution or Bay fill are more likely to think the Bay is polluted. The discriminant analysis and contingency table analysis reach identical conclusions. The additional information provided by the discriminant analysis is that the addition of other variables from this predictor set does not noticeably improve the relationship. This would be hard to demonstrate with contingency tables alone, because of the large number of three-way cross tabulations required to exhaust the combinations of variables taken three at a time that are logically related to the criterion of discrimination (the belief that the Bay is or is not polluted) and that can be shown to be significantly related to the criterion in bivariate tabulations.

Respondents who said the Bay is polluted were asked a series of questions to elaborate on this response, including Question 26c, "What do you think causes San Francisco Bay to be polluted?" The average number of causes mentioned per respondent was 2.1. City sewers,

industrial wastes and chemicals, and garbage dumping or Bay fill were each mentioned by 50-60 percent of the respondents.

Perhaps the most important aspect of this response pattern is that no single source of wastes received an overwhelming majority of the responses. Although a certain amount of scapegoating may be present in these responses, the majority of the respondents seem to have a perception of the causes of Bay pollution close to the reality of a complex system with multiple causes.

Apprehensions About The Bay

Some persons have apprehensions about the Bay which will be seen later to have a strong influence on the degree to which participation in recreational activities on the Bay is affected. Two questions were used to measure these apprehensions, Question 20a, "At the present time, do you feel that contact with Bay water could be harmful to a person in any way?" and Question 18a, "Would you eat fish caught in the Bay?" The latter question will be discussed further in Chapter III, but certain aspects of the relationship between these and other variables will be considered at this point.

Twenty-seven percent of the respondents thought contact with Bay water could be harmful to a person. Of these persons, 95 percent thought the harm would take the form of some medical ailment, external (such as skin irritations) or internal (such as intestinal disorders or a generalized, non-specific sickness). A third of the persons who thought the Bay could be harmful thought that it could be extremely harmful, 40 percent thought it could be somewhat harmful, and the

remaining one-fourth either thought it could be only slightly harmful or did not make a judgment.

In answer to Question 18a, 12 percent of the respondents gave a qualified response and 16 percent said they would not eat fish caught in the Bay. About 60 percent of the persons who gave either a qualified or negative response gave a reason coded as related to water pollution for not eating fish caught in the Bay.

The relationship between these two attitude questions that express apprehension about the Bay is shown in Table II-14. Persons who believe

TABLE II-14. EVALUATION OF BAY WATER SAFETY vs. WILLINGNESS TO EAT FISH CAUGHT IN THE BAY.

	Contact Could Be Harmful	Don't Know, Not Sure	Contact Could Not Be Harmful	Total
Would Eat Fish Caught in Bay	59%	66%	81%	72%
Would Eat Fish Under Certain Conditions	15	17	7	12
Would Not Eat Fish Caught in Bay	26	17	12	16
Total	100%	100%	100%	100%
Number of Cases	205	209	349	763

N - 763, Chi-square = 36.4, 4 degrees of freedom, .001 level of significance.

contact with Bay water could be harmful to a person are more likely not

to eat fish caught in the Bay than are those who believe contact could not be harmful. Conversely, (though the figures are not shown in Table II-14) persons who would not eat fish caught in the Bay are more likely to believe that contact with Bay water could be harmful to a person. The direction of association cannot be specified.

Opinions about the degree of threat posed by the Bay are strongly associated with perception of the present condition of the Bay (Table II-15). Of those persons who think contact with Bay water could be

TABLE II-15. EVALUATION OF BAY WATER SAFETY vs. EVALUATION OF BAY WATER QUALITY.

	Contact Could Be Harmful	Don't Know, Not Sure	Contact Could Not Be Harmful	Total
Bay is Polluted	86%	43%	36%	50%
Don't Know, Not Sure	10	45	34	32
Bay is Not Polluted	4	12	30	18
Total	100%	100%	100%	100%
Number of Cases	205	209	349	763

N = 763, Chi-square = 161.0, 4 degrees of freedom, .001 level of significance.

harmful to a person, twice as many also think the Bay is polluted as is the case among persons who do not believe contact with Bay water could be harmful.

Questions 18a, 20a, and 26a, (Would you eat fish..., Could contact

be harmful..., Is Bay polluted...) seem to form a cluster of attitudes and perceptions, highly interrelated, and all associated in the same direction with measures of the consequences of perceived Bay pollution, as will be discussed in Chapter III. These questions are, in turn, all strongly associated with the information variables.

As Question 18a will be discussed more thoroughly in Chapter III, only the relationship of Question 20a with other variables will be explored here. There were no strong associations between Question 20a and the demographic variables. A few relationships were statistically significant--sex, ethnic group, and education--but of no practical significance, maximum variations being a few percentage points.

The importance of information sources is underscored by the relationships shown in Tables II-16, II-17, and II-18. In all these tables, it can be seen that increasing amounts of information about the Bay are associated with greater likelihood of believing that contact with Bay water could be harmful to a person. Although the content of messages is not studied in this survey, it is clear that a negative tone is prevalent in the information that has been communicated about the Bay. In the light of published reports about the Bay in recent years, the content of the communicated messages is probably unnecessarily negative, because the Bay seems generally of good quality. This matter is discussed further in Chapter IV.

One would expect that persons who have become ill or suffered harmful effects from contact with Bay water would be more likely to believe that contact with Bay water could be harmful to a person. The relationship is shown in Table II-19. There is indeed a significant

TABLE II-16. INFORMATION ABOUT BAY POLLUTION vs. EVALUATION OF BAY WATER SAFETY.

	Heard Bay is Polluted	Don't Know, Not Sure	Have Not Heard Bay is Polluted	Total
Contact Could Be Harmful	36%	12%	10%	27%
Don't Know, Not Sure	26	41	27	27
Contact Could Not Be Harmful	38	47	63	46
Total	100%	100%	100%	100%
Number of Cases	502	34	227	763

N = 763, Chi-square = 66.4, 4 degrees of freedom, .001 level of significance.

TABLE II-17. RECENT INFORMATION ABOUT BAY POLLUTION OR FILL vs. EVALUATION OF BAY WATER SAFETY.

	Heard Recently	Haven't Heard Recently	Total
Contact Could Be Harmful	35%	15%	27%
Don't Know, Not Sure	26	30	27
Contact Could Not Be Harmful	39	56	46
Total	100%	100%	100%
Number of Cases	462	301	763

N = 763, Chi-square = 39.6, 2 degrees of freedom, .001 level of significance.

TABLE II-18. AMOUNT HEARD ABOUT BAY POLLUTION OR FILL
vs. EVALUATION OF BAY WATER SAFETY.

	Amount Heard				Total
	Great Deal	Somewhat	Not Much	Hardly Any	
Contact Could Be Harmful	50%	35%	18%	10%	27%
Don't Know, Not Sure	21	24	34	29	27
Contact Could Not Be Harmful	29	41	48	61	46
Total	100%	100%	100%	100%	100%
Number of Cases	132	238	198	195	763

N = 763, Chi-square = 85.1, 6 degrees of freedom, .001 level of significance.

TABLE II-19. HARM CAUSED BY CONTACT WITH BAY WATER vs.
EVALUATION OF BAY WATER SAFETY.

	Have Become Ill or Suffered Harmful Effects	Don't Know, Not Sure	Have Suffered No Harmful Effects	Total
Contact Could Be Harmful	69%	14%	27%	27%
Don't Know, Not Sure	0	64	27	28
Contact Could Not Be Harmful	31	21	46	45
Total	100%	100%	100%	100%
Number of Cases	13	14	887	914

N = 914, Chi-square = 22.5, 4 degrees of freedom, .001 level of significance.

relationship, though it is not as striking as might be expected. Moreover, one-third of those who have suffered harmful effects do not believe that contact with Bay water could be harmful to a person. Though the number of cases involved, using the full 914-case sample, is small, even here one can see the variability of response to a stimulus, the stimuli being on the one hand suffering harmful effects from Bay water and, on the other, the questions posed in the survey.

EXTENT OF CONTACT WITH THE BAY

Two measures of the extent of actual contact with the Bay are included in the questionnaire. The first, Question 3, is entirely of

visual contact, "How often do you see or look at any part of either San Francisco Bay or San Pablo Bay?" The second measure is of participation in recreational activities on the Bay, either in the past year or at some time prior to last year.

The distribution of responses to Question 3 is distinctly bimodal, with modal points at the extremes:

Frequency	Percent viewing Bay
Every day	24%
Two or three times a week	10
About once a week	10
Two-three times a month	12
About once a month	13
Less often than once a month	32

The median frequency of seeing the Bay is two-three times a month.

Relationships between frequency of seeing the Bay and the variables measuring attitudes toward the Bay are shown in Table II-20. Persons who see the Bay more often are more likely to believe the Bay is polluted.

A summary of participation in recreation activities on the Bay is given in Table II-21. Less than half the respondents have never participated in any recreation activity on the Bay while almost half have participated in one of the four major activities.

Relationships between participation in recreational activities on the Bay and attitudes toward the Bay are shown in Table II-22. In this table, participation means participation at some time, not necessarily last year. Some of these relationships are significantly different from zero as measured by the chi-square test, but few are large enough to be of any practical consequence. In all cases, persons who have at some

TABLE II-20. FREQUENCY OF SEEING BAY vs. ATTITUDE TOWARD THE BAY.

	Frequency of Seeing Bay				
	Every Day	2-3 Times a Week	Once a Week	2-3 Times a Month	Less Often Than Once a Month
Bay is polluted ¹	57%	58%	59%	52%	46%
Contact with Bay water could be harmful to a person ²	32	27	28	26	25
Would not eat fish caught in Bay ²	13%	8%	23%	17%	22%
Number of cases	175	74	71	96	249
					763

¹Chi-square = 23.0, 10 degrees of freedom, .02 level of significance.

²Relationship is not significant.

TABLE II-21. SUMMARY OF RECREATIONAL USE OF THE BAY.

Major Activities	<u>Percent Participating</u>	
	At Any Time	Last Year
None	53%	79%
One	28	16
Two	14	5
Three	4	*
Four	*	0
Boating or Sailing	34	13
Swimming	13	4
Water Skiing	2	*
Fishing	22	10
Other Recreation Activities	32	--
Major Activities plus other Activities	60	--

N = 914

TABLE II-22. PARTICIPATION IN RECREATIONAL ACTIVITIES ON THE BAY vs.
ATTITUDES TOWARD THE BAY.

	Boating	Swimming	Water Skiing	Fishing	Other Activities	Total
Bay is Polluted	58%	59%	50%	63%	50%	50%
Contact With Bay Water Could Be Harmful to a Person	31	27	28	34	26	27
Would Not Eat Fish Caught in Bay	12%	13%	11%	14%	12%	16%
Number of Cases	308	116	18	202	295	914

time participated in a recreation activity on the Bay are somewhat less likely to say that they would not eat fish caught in the Bay. Only the differences for boating, fishing, and other recreational activities are statistically significant. In all cases, persons who have used the Bay at some time are at least as likely as the population as a whole to say that the Bay is polluted and that contact with Bay water could be harmful to a person. The most striking observation is that people who have fished on the Bay at some time are much more likely to say that the Bay is polluted than are those who have not. It may be concluded that, in general, contact with the Bay does not cause a person to consider the Bay unpolluted.

III. CONSEQUENCES OF PERCEIVED POLLUTION

RECREATIONAL ACTIVITIES

Questioning Procedure

Five questions formed the operationalization of the process of determining whether a person had been affected by pollution. These five questions were embedded in a longer series of questions that is shown schematically in Figure III-1 and completely in the questionnaire reproduced in Appendix A. Each person was given an opportunity to give reasons for his non-participation or reduced level of participation in each of four recreational activities on the Bay (boating or sailing, swimming, water skiing, and fishing). Responses to the questions were recorded verbatim and included a wide variety of reasons. Consistent with the goals of the survey, they were grouped into three categories:

- a. Water pollution
- b. Other water characteristics
- c. All other

By recoding of the questions, other questions such as access to the Bay or the more specific issue of water temperature could have been studied but were not considered germane to the consideration of the effects of pollution alone. Multiple responses to these questions were accepted and coded. It is therefore possible in every case to ascertain whether pollution, e.g., was cited in conjunction with some other factor.

Overall Effects of Pollution

Table III-1 summarizes the responses given to the questions dealing with the four major recreational activities. Shown in this table are:

FIGURE III-1. SCHEMATIC DIAGRAM OF QUESTIONING PROCEDURE.

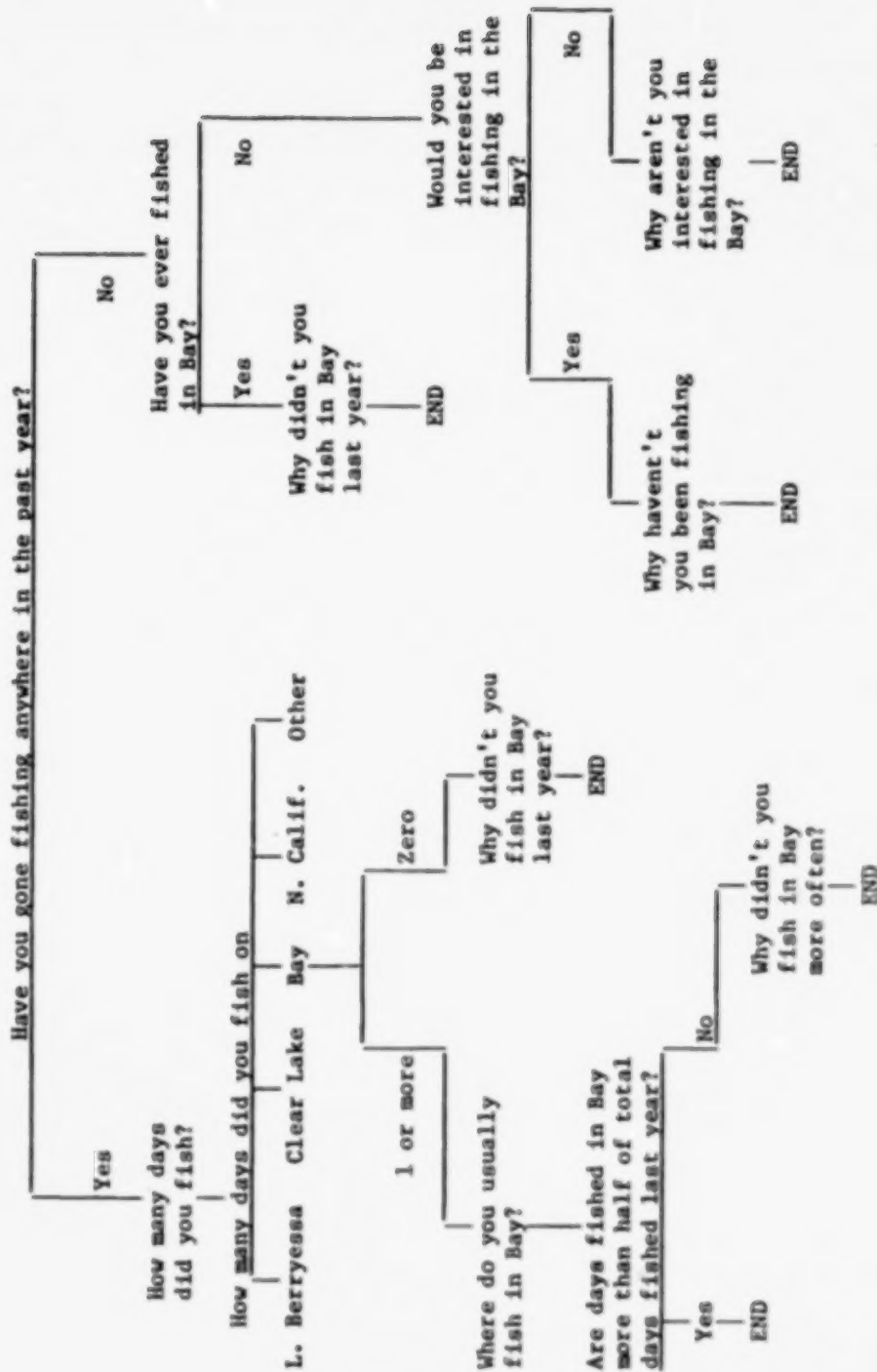


TABLE III-1. REASONS FOR NOT ENGAGING IN ACTIVITY ON SAN FRANCISCO BAY.
(All figures are in percent of total respondents)

	<u>Swimming</u>	<u>Water Skiing</u>	<u>Fishing</u>	<u>Boating or Sailing</u>
Single plus multiple responses				
1. Water pollution	20.2%	5.4%	2.4%	1.6%
2. Other water characteristics	36.0	14.1	6.4	7.5
3. All other reasons	56.3	85.0	83.4	78.7
Single responses only				
4. Water pollution	10.6	2.9	1.7	.9
5. Other water characteristics	21.0	8.5	3.9	5.0
6. All other reasons	45.6	80.0	80.8	76.4
Multiple responses only				
7. Water pollution and other water characteristics	6.6	1.5	.3	.4
8. Water pollution and all other reasons	2.3	1.0	.4	.2
9. Water pollution, other water characteristics, and all other reasons	.7	0	0	.1
10. Ratio of water pollution alone to total water pollution	52%	54%	71%	56%

a) the total proportions of persons citing reasons for non-participation or reduced participation (alone and in conjunction with other reasons); b) the proportions of persons who cited reasons in only one of the three categories; and c) the ratio of the proportion of persons citing only water pollution to the total proportion of persons citing water pollution.

Line 1 shows that swimming is the activity most affected by Bay pollution, with 20 percent of the respondents having cited it. Water skiing is next, with 5 percent, one-fourth of the proportion whose swimming activities have been affected. Fishing and boating or sailing are last with about 2 percent each.

Lines 4 and 10 show that the majority of the persons citing pollution give it as the only reason.

Lines 2 and 3 show that in all cases, both other water characteristics and all other reasons outrank pollution as reasons for non-participation or reduced participation in the activity on the Bay. Many of these factors other than pollution are of potential interest in the management of the Bay, but, apart from the fact that certain proportions of the respondents mentioned one or more of these other factors in conjunction with water pollution, they are not of particular relevance to the present investigation.

The percentages of persons who said that pollution has affected their recreational activities are compared in Table III-2 with the percentages of persons who participated in the activity last year, anywhere and on the Bay. This table shows that the number of persons for whom water pollution is a reason for not swimming in the Bay is

TABLE III-2. EFFECTS OF PERCEIVED POLLUTION ON AND PARTICIPATION IN RECREATIONAL ACTIVITIES, BY ACTIVITY.

	Swimming	Water Skiing	Fishing	Boating or Sailing
Total Affected by Pollution	20%	5%	2%	2%
Affected by Pollution (Only reason)	11	3	2	1
Participated in Activity on Bay last year	4	*	10	13
Participated in Activity Anywhere last year	30	7	28	27
Ever Participated in Activity on Bay	12%	2%	22%	33%

N = 763

two-thirds as large as the total number of persons who went swimming somewhere besides swimming pools last year. The number of persons who cited pollution as the only reason is almost as large as the number of persons who have ever been swimming in the Bay, and is five times as large as the number who went swimming in the Bay last year. These figures do not include teenagers and children under 12 years of age. (Younger persons were not included in the survey because of the desire to study a wide range of attitude and information factors.)

If the conservative assumption is made that the proportion of persons under 18 years of age whose swimming activity is affected by pollution is at least as great as that of the population as a whole,

approximately 1,000,000 persons in the Bay Area are affected. This estimate is considered conservative because a higher proportion of younger persons swim (Outdoor Recreation Resources Review Commission, 1962, p. 214) and because the present survey shows that as age decreases, the proportion of persons affected increases.

These figures do not imply that if perceived pollution were removed as a reason for not swimming in the Bay, 20 percent of the population would then swim in the Bay. It is conceivable that those persons who cited other reasons in addition to pollution would refrain from swimming in the Bay because of these reasons. It is also conceivable that persons who have expressed perceived pollution as the only reason might, after attempting to swim in the Bay, find other reasons such as access and water temperature to be sufficient deterrents to swimming in the Bay.

Two issues are involved. One is the effect of perceived pollution on recreational activities. The other is the possible increase of recreational use of the Bay. It must be concluded by definition that perceived pollution is affecting all the persons who cited it as a reason for not swimming in the Bay (20 percent of the respondents). If, at some time in the future, as a result of a combination of circumstances, perceived pollution were not considered a deterrent to swimming in the Bay, the effect of perceived pollution would be reduced to zero. Potential increase in swimming use of San Francisco Bay, however, cannot be accurately estimated from this survey and from assumptions about future water quality conditions in the Bay. It can only be said that if perceived pollution is eliminated as a basis for not swimming in

the Bay, there is virtually certain to be an increased tendency for swimming in the Bay. Other deterrents, such as access and temperature, may be so strong that the actual increase in swimming could be small or zero.

It should be appreciated that the operational definition of a pollution effect is a particular kind of measure. It is not an exhaustive definition. E.g., if increased swimming use of the Bay were a desired program goal, further analysis of the detailed structure of responses, particularly those in which pollution and other reasons were given, would be required.

Referring again to Table III-2, it is seen that the percentage of persons citing pollution as a reason for not water skiing in the Bay is high relative to the percentage of persons who water skied anywhere last year and who have ever water skied on the Bay. It is just as true for water skiing as for swimming that the elimination of perceived pollution as a reason for non-participation does not imply an increase of water skiing in the Bay equal to the proportion of persons giving pollution as a reason.

Fishing and boating or sailing are affected to a relatively small degree, compared with the proportion of persons who: a) used the Bay last year for the activities; or b) have participated in the activity somewhere last year; or c) have participated in the activity on the Bay at some time.

An additional set of figures is useful in evaluating potential demand for recreational activities on the Bay. Persons who did not participate in the activity anywhere during the past year and who have

never used the Bay for the activity were asked whether they would be interested in using the Bay for the activity. These responses overlap those used for determining whether a person had been affected by perceived pollution (Table III-3). These figures indicate that the

TABLE III-3. PERCENT OF PERSONS INTERESTED IN PARTICIPATING IN RECREATIONAL ACTIVITY ON THE BAY.

Boating	18%
Swimming	5
Water Skiing	12
Fishing	12%

N = 914

potential demand is relatively large for each of the activities, except swimming. The figure for swimming is misleadingly low because over 10 percent of the respondents were not interested in swimming in the Bay because of water pollution.

In order to make effective use of the information that certain proportions of the population are refraining from participation in an activity on the Bay because of pollution, it is desirable to know more about the relationship of this response to other responses. It is of importance to know whether these persons differ from the rest of the population and, if so, how and to what degree.

The variables of most importance in determining whether a person's recreational activities have or have not been affected by Bay pollution

are the attitude and information variables. One of the most important is Question 20a, "Do you feel that contact with Bay water could be harmful to a person in any way?" (Table III-4). The proportions of

TABLE III-4. EVALUATION OF BAY WATER SAFETY vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Contact Could be Harmful to a Person	Contact Could Not Be Harmful and Don't Know	Total
Any Activity	42%	17%	24%
Swimming	40	15	20
Water Skiing	14	3	5
Fishing	4	2	2
Boating or Sailing	4%	1%	2%
Number of Cases	205	558	763

persons whose recreational activities have been affected by perceived Bay pollution are in all cases much higher--by a factor of 2-4--among persons who believe that contact with Bay water could be harmful to a person.

A similar pattern is seen for the relationship between whether a person's recreational activities have been affected and whether he would be willing to eat fish caught in the Bay (Table III-5). In all cases, the proportion of persons whose recreational activities have been affected by pollution is at least 60 percent higher among persons who would not eat fish caught in the Bay than among persons who would

TABLE III-5. WILLINGNESS TO EAT FISH CAUGHT IN BAY vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Would Not Eat Fish	Would Eat Fish	Total
Any Activity	35%	19%	24%
Swimming	30	18	20
Water Skiing	9	4	5
Fishing	9	*	2
Boating or Sailing	4%	1%	2%
Number of Cases	222	541	763

be willing to eat fish caught in the Bay.

Evaluation of the present condition of the Bay is likewise very distinctly related to whether a person's recreational activities have been affected (Table III-6). In all cases, the proportions of persons

TABLE III-6. EVALUATION OF BAY WATER QUALITY vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Bay is Polluted	Don't Know, Not Sure	Bay is Not Polluted	Total
Any Activity	33%	14%	14%	24%
Swimming	30	13	14	20
Water Skiing	10	2	1	5
Fishing	5	1	0	2
Boating or Sailing	3%	1%	1%	2%
Number of Cases	390	235	138	763

whose recreational activities have been affected by pollution is more than twice as great among persons who think the Bay is polluted as among persons who do not think the Bay is polluted or are not sure.

These three indicators of perception of Bay water quality are good, but not perfect, predictors and the reasons are apparent. A person could think the Bay is polluted or believe contact with Bay water could be harmful to a person or not wish to eat fish caught in the Bay and yet have no interest in any of the recreational activities for reasons other than perceived Bay pollution.

Because perception is closely associated with information and because effects of pollution on recreational activities depend, apparently, on perception, one would expect to find a relationship between the information measures and the proportions of persons whose recreational activities have been affected by perceived Bay pollution. Tables III-7 through III-9 show the relationship for three of the information measures. Increasing information is associated with greater proportions of persons being affected.

The interpretation of the significance of the information measures could proceed in two ways. It could be said that as persons come to "know the facts", they avoid the Bay. It could also be said that the information content of messages used by persons to form opinions about the Bay is negative and that this is why people have a negative opinion of the Bay. Up to this point, it is irrelevant whether a negative information content is appropriate for description of Bay water quality.

In terms of formal quality characteristics, those for which numerical evaluations can be made by scientific analysis, there is

TABLE III-7. INFORMATION ABOUT BAY POLLUTION vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

<u>Activity Affected</u>	<u>Heard Bay is Polluted</u>	<u>Don't Know, Not Sure</u>	<u>Have Not Heard Bay is Polluted</u>	<u>Total</u>
Any Activity	29%	6%	15%	24%
Swimming	26	6	14	20
Water Skiing	8	0	2	5
Fishing	4	0	0	2
Boating or Sailing	2%	0%	2%	2%
Number of Cases	502	34	227	763

TABLE III-8. RECENT INFORMATION ABOUT BAY POLLUTION OR FILL vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

<u>Activity Affected</u>	<u>Heard Recently</u>	<u>Haven't Heard Recently</u>	<u>Total</u>
Any Activity	30%	15%	24%
Swimming	26	15	20
Water Skiing	8	3	5
Fishing	3	2	2
Boating or Sailing	2%	1%	2%
Number of Cases	462	301	763

TABLE III-9. AMOUNT HEARD ABOUT BAY POLLUTION OR FILL vs. EFFECTS OF PERCEIVED POLLUTION POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Amount Heard				Total
	Great Deal	Somewhat	Not Very Much	Hardly Any	
Any Activity	38%	32%	22%	7%	24%
Swimming	35	29	20	6	20
Water Skiing	11	8	3	3	5
Fishing	7	4	1	1	2
Boating or Sailing	4%	2%	2%	1%	2%
Number of Cases	132	238	198	195	763

little in the published record that could be interpreted as justifying a negative information content (and it should be appreciated that such a statement must necessarily be somewhat subjective and depend upon a particular point of view). The State of California cites some quality problems (State Policy, 1967, pp. I-6 through I-8), but the worst problems are indicated as being in the southern portion of the Bay and in San Pablo Bay. The Bay is used most for recreational activities in the zones of best quality, between San Mateo Bridge and the Richmond-San Rafael Bridge (Table III-10). It is quite likely that, based on formal characterization of Bay water quality, the information content of messages about the Bay is unduly negative.

As pointed out in the previous chapter, formal characterizations of water quality do not normally deal adequately with the factors that

TABLE III-10. LOCATION OF RECREATIONAL ACTIVITY ON THE BAY.

Zone	Boating or Sailing	Swimming	Water Skiing	Fishing
A (South of San Mateo Bridge)	10%	11%	**%	8%
B (San Mateo Bridge to Bay Bridge)	20	31	**	25
C (Bay Bridge to Richmond-San Rafael Bridge)	42	44	**	41
D (North of Richmond- San Rafael Bridge)	28	14	**	26
Total	100%	100%	N.A.	100%
Number of Cases	120	27	1	88

N = 914

**The one person who had water skied on the Bay did not say where he had skied.

are of most concern to the public at large. It is therefore quite possible that even if chemical and bacteriological analyses of the Bay revealed water of high quality, the factors noticed by the public might be very much in evidence. The State does in fact mention (State Policy, 1967, p. I-10) that oily wastes are discharged into the Bay, though the extent of the discharge and the water affected by it are not detailed.

The relationships between several demographic characteristics and

the proportions of persons who reduce or refrain from participation in one or more recreational activities because of perceived pollution of San Francisco Bay are shown in Tables III-11 through III-17. The

TABLE III-11. SEX vs. EFFECTS ON PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

<u>Activity Affected</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>
Any Activity	27%	21%	24%
Swimming	25	18	20
Water Skiing	6	6	5
Fishing	4	1	2
Boating or Sailing	2%	1%	2%
Number of Cases	382	381	763

TABLE III-12. AGE vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Under 25	25-34	35-44	45-54	55-64	65 or older	Total
Any Activity	31%	30%	26%	27%	19%	11%	24%
Swimming	28	27	24	24	16	10	20
Water Skiing	10	13	5	4	5	0	5
Fishing	4	2	1	3	6	2	2
Boating or Sailing	2%	5%	2%	1%	1%	0%	2%
Number of Cases	89	149	168	142	85	130	763

TABLE III-13. HOUSEHOLD INCOME vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Under \$5000	\$5000-7499	\$7500-9999	\$10000-14999	Over 14999	Refused	Total
Any Activity	15%	20%	26%	34%	28%	15%	24%
Swimming	12	19	24	31	26	13	20
Water Skiing	3	5	10	7	6	3	5
Fishing	3	3	4	2	3	0	2
Boating or Sailing	1%	2%	4%	2%	1%	0%	2%
Number of Cases	162	131	141	180	88	61	763

TABLE III-14. EDUCATION vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Less Than High School	High School Graduate	Some College	College Graduate	Total
Any Activity	16%	23%	27%	34%	24%
Swimming	14	21	24	32	20
Water Skiing	4	5	8	8	5
Fishing	2	3	4	2	2
Boating or Sailing	1%	2%	4%	1%	2%
Number of Cases	204	239	186	134	763

TABLE III-15. HOUSEHOLD COMPOSITION vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

Activity Affected	Children Under 18	No Children Under 18	Total
Any Activity	28%	20%	24%
Swimming	25	19	20
Water Skiing	7	4	5
Fishing	3	3	2
Boating or Sailing	3%	1%	2%
Number of Cases	404	359	763

TABLE III-16. EMPLOYMENT STATUS vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

<u>Activity Affected</u>	<u>Employed Full Time</u>	<u>Employed Part Time</u>	<u>Unemployed</u>	<u>Total</u>
Any Activity	27%	12%	17%	24%
Swimming	25	12	14	20
Water Skiing	8	0	2	5
Fishing	2	0	4	2
Boating or Sailing	2%	0%	1%	2%
Number of Cases	530	33	200	763

TABLE III-17. LENGTH OF RESIDENCE IN BAY AREA vs. EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

<u>Activity Affected</u>	<u>Less than 1 Year</u>	<u>1-2.9 Years</u>	<u>3-4.9 Years</u>	<u>5-9.9 Years</u>	<u>10 or More Years</u>	<u>Total</u>
Any Activity	3%	18%	24%	21%	26%	24%
Swimming	3	16	22	21	23	20
Water Skiing	0	8	8	4	6	5
Boating or Sailing	0%	2%	4%	1%	2%	2%
Number of Cases	34	49	50	68	562	763

effects of perceived pollution are greater for men than for women, and are consistently greater for young persons than older persons. Increasing proportions of persons modify their swimming activities because of perceived pollution as income increases, up to the \$10,000-\$14,999 per year group, above which there is a decline. The decrease begins at a lower level for water skiing, fishing, and boating or sailing. The more education a person has, the more likely it is that he modifies his swimming activities in the Bay because of perceived pollution. For the other activities, the group most affected is the group which has had some college, business, or technical school training, but has not graduated from college. Persons from households with children are more likely to modify their recreational activities than are persons from households without children under 18 years of age. Persons employed full time are more likely to be affected than are persons who are employed part time or are unemployed, for all activities but fishing, for which unemployed persons are affected more than persons employed full time.

To more nearly complete the description of the things that differentiate between persons whose recreational activities on the Bay have been affected by perception of Bay pollution from the population as a whole, more than one variable must be used. Demographic, information, and attitude variables interact in a complex manner and the relationships can neither be conveniently explored nor displayed in bivariate tabulations. A multivariate technique, discriminant analysis, was used to consider simultaneously the joint effects of several variables in classifying a subject into one of two groups--persons whose

recreational activities on the Bay have been affected by perceived pollution and those whose activities have not been affected.

In discriminant analysis, a linear function of variables in the predictor set is calculated. In the procedure used for analysis in this investigation, a function is computed for each of the groups (Dixon, 1967, pp. 214a-214u). A subject is assigned to the group for which his function score is highest. For example, in the two group case, if his score for Group A is 5 and for Group B is 1, he would be assigned to Group A. There are other decision rules that can be used for case assignment. If one wished to be more sure of classifying subjects of one group correctly, such a decision rule can be formulated, at the cost of incorrectly classifying more cases of the other group.¹

The discriminant analysis was based on the predictor set listed in Table III-18.² Five of the predictors--"How much have you heard about Bay pollution or fill?", "How polluted do you think the Bay is?", Educational background of respondent, "Would you eat fish caught in the Bay?", and "Are there teenagers or children under 12 in the household?"--give almost as high a degree of discrimination as does the full set. The overall accuracy of assignment for the random half used in developing the functions was 71 percent as compared with 73 percent for the full predictor set. For the other random half, the accuracy was 70 percent as compared with 72 percent for the full predictor set.

For the random half of the 765-case subsample that was used to develop the discriminant functions, 72 percent of the affected group

Explanatory notes at end of chapter.

TABLE III-18. PREDICTOR SET FOR EFFECTS OF PERCEIVED POLLUTION ON RECREATIONAL ACTIVITIES.

1. Age--Under 25; 25-34; 35-44; 45-54; 55-64; 65 or older
2. Sex--Male; female
3. Ethnic Group--Non-white; white
4. Education--Less than high school; some high school, not completed, no answer; completed high school; some college, business, or technical school; college graduate; post college graduate work
5. Teenagers or children under 12 in household--No, Yes
6. Time spent on outdoor recreation activities during a typical week--No answer, none; less than 1 hour; 1 hour-1.9 hours; 2 hours-3.9 hours; 4 hours-5.9 hours; 6 hours-7.9 hours; 8 hours-9.9 hours; 10 hours-14.9 hours; 15 hours or more
7. Would you eat fish caught in San Francisco Bay?--Yes; qualified; no
8. How much have you heard about Bay pollution or Bay fill?--Great deal; somewhat; not very much; hardly any
9. Have you ever heard the Bay is polluted?--No, yes
10. Do you think the Bay is polluted now?--No, yes
11. Could contact with Bay water be harmful to a person?--Yes; don't know, not sure; no
12. Frequency of seeing Bay--Every day; 2-3 times a week; about once a week; 2-3 times a month; about once a month; less often than once a month, no answer
13. Have you ever attended meetings where Bay pollution or fill was discussed?--No, yes
14. How polluted do you think the Bay is?--extremely polluted; somewhat polluted; only slightly polluted; not polluted
15. What features do you dislike about the Bay?--All others, water pollution.

and 71 percent of the unaffected group were correctly assigned. For the other random half, 64 percent of the affected group and 70 percent of the unaffected group were correctly assigned.

The functional relationship of these predictors to group membership was such that a person who had heard less about Bay pollution or fill, who thought the Bay was more polluted, who had more education, who wouldn't eat fish caught in the Bay and who had teenagers or children in his household was more likely to say that he had refrained from or reduced his participation in some recreational activity in the Bay because of water pollution. The probabilistic nature of this statement is important because these conditions are neither necessary nor sufficient. They indicate only that a person with these characteristics has a higher probability of being affected by pollution than do persons without them. Unmeasured are social pressures on the person to be interested in outdoor, water-oriented recreation, the person's cultural history and values, and the nature of his other commitments. If information were available on these other factors, a higher degree of predictive accuracy would be expected. It is doubtful that acquisition of this information would be desirable. It would constitute a severe invasion of privacy for the respondent and would be hard to use in planning. Direct acquisition of data on the effects desired seems preferable. This subject will be discussed further in Chapter IV.

WILLINGNESS TO EAT FISH CAUGHT IN BAY

Question 18a asks, "Would you eat fish which were caught in the Bay? This question has been discussed before as an aspect of percep-

tion of Bay pollution and as a predictor in the case of effects on recreational activities. The question is useful for these purposes but it has a larger importance in that it is a measure of another effect of perceived pollution of the Bay. Sixteen percent of the respondents felt strongly enough about the undesirability of eating fish caught in the Bay that they said they would not eat them. An additional 12 percent gave a qualified response; they would eat fish caught in the Bay if they could be assured of their safety or they would eat only certain species. Because safety of the fish or unpalatability of the fish is the matter of most concern to those who were unwilling to eat fish caught in the Bay and because these conditions are thought by the respondents to be dependent on the condition of Bay water, this seems clearly an effect of perceived polluted water on the residents of the Bay Area.

Perceptual factors are most closely associated with responses to this question (Tables III-19 and III-20). Persons who believe the Bay is not polluted are twice as likely to eat fish caught in the Bay as persons who believe the Bay is polluted or who don't know. Persons who believe contact with Bay water could not be harmful to a person are more likely to eat fish caught in the Bay than are persons who do believe contact could be harmful or are not sure.

Information measures are not as good predictors of whether a person is unwilling to eat fish caught in the Bay as are the perception questions mentioned above (Tables III-21 and III-22). The more a person has heard about Bay pollution or Bay fill, the less likely he is to eat fish caught in the Bay. However, it is not sufficient merely

TABLE III-19. EVALUATION OF BAY WATER QUALITY vs. WILLINGNESS TO EAT FISH CAUGHT IN BAY.

	Bay is Polluted	Don't Know, Not Sure	Bay is Not Polluted	Total
Would Not Eat Fish Caught in Bay	23%	11%	12%	16%
Would Eat Fish Under Certain Conditions	12	16	4	12
Would Eat Fish Caught in Bay	65	73	84	72
Total	100%	100%	100%	100%
Number of Cases	390	235	138	763

N = 763, Chi-square = 31.5, 4 degrees of freedom, .001 level of significance.

TABLE III-20. EVALUATION OF BAY WATER SAFETY vs. WILLINGNESS TO EAT FISH CAUGHT IN BAY.

	Could be Harmful to a Person	Don't Know, Not Sure	Could Not be Harmful to a Person	Total
Would Not Eat Fish Caught in Bay	26%	17%	12%	16%
Would Eat Fish Under Certain Conditions	15	17	7	12
Would Eat Fish Caught in Bay	59	66	81	72
Total	100%	100%	100%	100%
Number of Cases	205	209	349	763

N = 763, Chi-square = 36.4, 4 degrees of freedom, .001 level of significance.

TABLE III-21. AMOUNT HEARD ABOUT BAY POLLUTION vs. WILLINGNESS TO EAT FISH CAUGHT IN BAY.

	Great Deal	Somewhat	Not Much	Hardly Any	Total
Would Not Eat Fish Caught in Bay	23%	19%	13%	15%	16%
Would Eat Fish Under Certain Conditions	7	15	14	10	12
Would Eat Fish Caught in Bay	70	66	74	75	72
Total	100%	100%	100%	100%	100%
Number of Cases	132	238	198	195	763

N = 763, Chi-square = 13.8, 6 degrees of freedom, .05 level of significance.

TABLE III-22. INFORMATION ABOUT BAY POLLUTION vs. WILLINGNESS TO EAT FISH CAUGHT IN BAY.

	Heard Bay is Polluted	Don't Know, Not Sure	Have Not Heard Bay is Polluted	Total
Would Not Eat Fish Caught in Bay	19%	29%	12%	16%
Would Eat Fish Under Certain Conditions	12	9	12	12
Would Eat Fish Caught in Bay	69	62	76	72
Total	100%	100%	100%	100%
Number of Cases	502	34	227	763

N = 763, Chi-square = 8.6, 4 degrees of freedom, .10 level of significance.

to have heard the Bay is polluted. Persons who have heard the Bay is polluted are not much less likely to eat fish caught in the Bay than are persons who haven't heard the Bay is polluted. Persons who have heard the Bay is polluted are more likely to eat fish caught in the Bay than are those who don't know whether they have heard the Bay is polluted.

Education is significantly related to whether a person would be willing to eat fish caught in the Bay. The relationship is shown in Table III-23. This table shows a definite trend; as education level decreases, the proportion of persons unwilling to eat fish caught in the Bay increases.

TABLE III-23. EDUCATION vs. WILLINGNESS TO EAT FISH CAUGHT IN BAY.

	Less than High School	High School	Some College	College Graduate	Total
Would Not Eat Fish Caught in Bay	23%	17%	17%	8%	16%
Would Eat Fish Under Certain Conditions	10	10	17	11	12
Would Eat Fish Caught in Bay	67	73	66	81	72
Total	100%	100%	100%	100%	100%
Number of Cases	204	239	186	134	763

N = 763, Chi-square = 18.2, 6 degrees of freedom, .01 level of significance.

PHYSICAL HARM

In the total sample, $N = 914$, 1.4 percent of the respondents said that they had personally become ill or suffered harmful effects from Bay water. An additional 1 percent didn't know or were not sure. There was some regional variation. On the Peninsula, 2.9 percent had suffered harmful effects, while the proportions were 2.5 percent in the East Bay and 1.5 percent in the North Bay.

The most significant aspect of this information is that the number of persons whose health was actually affected by Bay water is such a small fraction of the persons who thought that Bay water could be harmful to a person--5 percent of those who thought that it could and 3 percent of those who either thought it could or weren't sure.

Persons who said they had become ill or suffered harmful effects from contact with Bay water were not significantly different from the population as a whole, in attitudes, demographic characteristics, degree of contact with the Bay in major recreational activities, or amount of information heard about the Bay.

EXPLANATORY NOTES

¹In a survey of this sort, many of the variables are highly intercorrelated. Demographic variables are intercorrelated with each other, information variables are intercorrelated with each other and with perception variables, and the perception variables are intercorrelated with each other. In most cases, there is no logical basis for demonstrating the absolute primacy of one variable over another in a predictor set. Thus, it is possible for several combinations of predictors to have roughly equal predictive power. The functional relationships presented should not be considered the only possible set of relationships.

²It is frequently stated that one should not use a multivariate technique unless one has a logical basis for including variables in the predictor set. The survey analyst finds some but little guidance in such an admonition. Even by following it rigorously, he may be left with a number of predictors that are logically related to the dependent variable and for which the direction of the relationship can be established a priori. E.g., one would expect recreational activity for water skiing and swimming to decline with age; men would be expected to fish more than women; higher income persons would be expected to boat or sail more than lower income persons; persons who think the Bay is polluted would be expected to be more likely to curtail recreational activities in the Bay than persons who did not; etc. In such a circumstance, the features of stepwise discriminant analysis are very appealing, because at each step, the variable added to or removed from the predictor set is the variable that makes the largest contribution

to discrimination at this point.

Cooley and Cohnes have expressed a reservation about stepwise regression techniques that seems equally applicable to stepwise discriminant techniques, particularly for the two-group case for which discriminant analysis and regression analysis are identical. Their concern is that, since only the criterion or dependent variable is treated as subject to errors, ". . . any effort to generalize from sample to population is open to serious danger of capitalization on chance" (1962, p. 35).

As a partial check on this danger, a 765-case subsample (probability proportionate to size of subregion) was divided into random halves. The discriminant analysis was performed on one half and checked on the other.

IV. POLICY AND PROGRAM IMPLICATIONS

In preceding chapters, it has been shown that many people are not participating in certain recreational activities in San Francisco Bay because they believe it to be polluted and undesirable for use. The activities most affected are swimming (20 percent of the adult population of the Bay Area) and water skiing (5 percent of the adult population). Boating and fishing are affected very little (less than 2 percent each). The characteristics of the Bay objected to most often are odors and visual evidences of "pollution." The visual evidences are such things as oil, debris, foam, etc. In addition to their own evaluations of the Bay, perceptions of and attitudes toward the Bay are shown to be primarily related to what and how much has been heard about the Bay.

In this chapter, implications of these and other findings for policies and programs will be considered. Although both legislative and administrative implications will be discussed, the discussion is primarily concerned with implications for administrative agencies.

The number of persons who modify their recreational use of the Bay because they believe it to be polluted may appropriately be considered in the justification of public pollution control programs (to the extent that public programs could reduce the extent of this recreational use curtailment). New programs may be justified to deal with those aspects of pollution that are of most concern to the public. For example, the concern about visible material on the surface of the Bay suggests the use of a corps of workers to continuously patrol and clean up areas of beach or water surfaces, at least through recreation

seasons. It also suggests surveillance activities on a routine basis to identify sources of substances that are discharged into the Bay and to take immediate, on-the-spot action to eliminate such discharges. Such surveillance would be in accordance with State policies, though implementation of the policy has not taken this form and clean-up work has apparently been the responsibility of the Army Corps of Engineers (State Policy, 1967).

The expressed demand for greater recreational use of the Bay suggests the need to develop, in the short run, more recreational areas and to "sell the Bay". Popular conception (Gilliam, 1957) and public reports (Bay Conservation and Development Commission, 1968, p. 9) have taken the position that use of the Bay for swimming and water skiing is severely restricted by its temperature. While this does indeed seem to be the case for many people, a large group of persons mention pollution as a primary reason for not swimming or water skiing on the Bay. Indeed, over half of the persons who cited pollution as a reason for non-participation gave it as the only reason. These responses cannot be taken as conclusive proof that if pollution were removed as a reason for non-participation, these persons would then use the Bay for swimming and water skiing. It is an indicator that must be tested to be verified.

The removal of perceived pollution as a cause for non-participation requires the removal of barriers to participation. These barriers include the factors that cause persons to consider the Bay polluted, those that are observable with the unaided, untrained eye and nose as well as those that can only be detected by careful scientific analysis.

Other barriers include information a person has about the Bay and the attitudes he has developed about the Bay over the years.

Removal or reduction of pollution sources historically has been virtually the sole focus of quality control agencies. The provision of sewage treatment facilities, policing of discharges into the Bay, garbage dumping, filling, etc. are examples of such measures. Attitude and information barriers have received little attention. If anything, quality control agencies have erected attitude barriers, taking the form: "Fight for Clean Water". It is not proposed that this orientation be dropped if it is relevant to the particular case at hand, but it is exceedingly detrimental if it is not relevant. In the case of San Francisco and San Pablo Bays, it applies to some portions of the Bay and not to others. Because it doesn't apply as well to those portions of the Bay most used for recreational activities--San Mateo Bridge to Richmond-San Rafael Bridge--typifying the whole Bay as polluted is detrimental to recreational use of these portions of the Bay. If it were the case that the public could only conceive of the Bay as a single entity that was either polluted or unpolluted, perhaps a posture that the Bay is polluted is justified in order to gain support for cleaning up those portions of the Bay that are polluted. However, there is no evidence that the public has such a limited conception of the Bay nor that it has such a limited capacity for discrimination.

These comments suggest that a more aggressive effort be made by public agencies to portray the condition of the Bay, as it is, in sufficient detail to correct misconceptions of the condition of the Bay and to encourage recreational use of the Bay.

A public information program of this sort could take several forms. Of particular value would be a brochure on the Bay that included verbal descriptions of various portions of the Bay and maps, such as the fishing maps distributed by the California Department of Fish and Game (Department of Fish and Game, 1965), that locate points of access, beaches, launching ramps for water-skiing boats, and give graphic portrayals of water conditions in addition to the verbal descriptions.

In such an information program, safety is an issue central to the use of the Bay for body contact sports that must be faced. Bacteriological standards have been set by health agencies for body contact sports by the State of California that are similar to those used in other states (State Policy, 1967). The Public Health Activities Committee of the American Society of Civil Engineers (1963), in a review of standards like these, concluded that they have no basis in epidemiology. The relationship between bacteriological quality and safety for public use has not been established. Should these standards then be used in the evaluation of the suitability of water for swimming and water skiing? This question obviously involves value questions and ethical decisions. It may be argued that public agencies have a responsibility to protect the public by establishing and enforcing standards even in the absence of evidence that would support the guidelines. It may also be argued that if the facts are not given to the public, an enforcement policy is basically dishonest.

The proper role of a quality control or health agency in this situation would seem to be that of collecting information, conducting research, disseminating information, and allowing the public to take

some risk now being assumed by the health agencies. The dissemination of information might then include statements about the validity of the standards currently being used for beach closing. Bacterial counts could continue to be reported, if desired, thus allowing an individual to base his actions on the old standards if he wished, though logical consistency would dictate their omission until such time, if ever, as they were found to be useful.

Turbidity and floating material are of primary concern to immediate perception of water quality by potential participants in body contact sports. These aspects of Bay water quality vary considerably, depending upon wind conditions, inflow of water to the Bay system, and discharges of pollutants (including accidental discharges) into the Bay. Because these aspects of water quality do vary so widely, long-term conditions seem of little use in making a decision to use or not use the Bay for a recreational activity. To provide up-to-date information, it is suggested that frequent, perhaps daily, reports of at least turbidity and floating material be disseminated by public agencies during at least the seasons of heavy recreational use, in much the same manner as weather reports are disseminated by the U.S. Weather Bureau. Initially, these reports would be general and qualitative. Quantitative indexes of pollution, if and when they are developed for the Bay, would be useful. (Air pollution reports by the news media, e.g., quote the concentrations of substances together with limits at which eye irritation is considered likely to take place.) Because personal decisions are partially based on qualitative evidence (much of it probably hearsay evidence at that) such as appearance and odor, the

use of qualitative data presents no problems, assuming that satisfactory observers can be obtained. The use of qualitative data may well represent an improvement in the measurement of water quality because of the inferior role to which qualitative data is relegated in evaluating the condition of a water body by quality control agencies.

In addition to the effect of information programs on recreational activities, an effect could be expected on that portion of the population which at present would not eat fish caught in the Bay because the fish are considered unsafe. If the fish actually are unsafe, everyone should abstain from eating them. However, there seems to be little basis for judging that fish caught in the Bay are unsafe for consumption. (Taste is a factor that, of course, lies beyond the scope of this statement because it is such an individual matter. A safe fish might not necessarily taste good.) This subject would properly be dealt with in both the brochures and in the daily reports.

A discussion by Gross (1966, pp. 166-167) is germane to the subject of quality measurement of Bay water. Gross makes a comment about the accuracy of data that seems strikingly appropriate to the present discussion. Following a consideration of Morgenstern's treatise on "The Accuracy of Economic Observations" (1963, pp. 242-282) in which Morgenstern pleads for more accurate data, and, more important, an estimate of the error associated with reported data, Gross says:

"Yet, as against the dangers flowing from errors in economic statistics, I must also point out, as no less dangerous, the bias resulting from accurate economic statistics. Greater accuracy may easily bring with it greater irrelevance. For example, the most accurate part of a company's balance sheet is its statement of cash on hand. To focus on this alone would be a ridiculous way of analyzing a company's financial position. The balance sheet, as a whole, does not reflect the assets that the company enjoys in the form of its clients' good will and the support of its cooperating organizations. These 'intangible' factors, however, cannot be dealt with as quantitatively as the estimated value of inventories and receivables. Hence, they tend to be ignored by executives who are hypnotized by the quantitative data in the balance sheet. (To repeat what has been said before, the fact that a variable can be quantified--by present techniques--may be illusory or deceptive.)"

The preceding discussion brings up the subject of quality standards in relation to recreational activities. For purposes of enforcement, it is desirable, perhaps imperative, to have a standard of comparison, a basis for saying that certain actions are required for quality control. If there were complete agreement between polluter and agency, standards would not be required, but agreement is not universal, to say the least.

On the other hand, the evidence collected in this study would indicate that there may be little relationship between formal characterizations of quality levels and recreational use of a water body, because perception of quality is the determining factor in recreational use of a water body, and perception of quality may be greatly at variance with formal characterization of the quality of that water body.

Even if data collection programs such as described in preceding paragraphs were instituted, the information linkage between data collection agency and user is a modifying factor. The information programs described above might completely surmount this difficulty but

they remain to be tested. However, such extensive data collection and information programs are not in existence at the present time. The value of standards for recreational waters is in doubt for these reasons, and would be even more in doubt if recreational standards were the results of a national or regional policy that was not responsive to the local situation. The current state of the art is such that quality standards for recreational waters must necessarily be kept flexible to adapt to differing perceptions and standards of judgment and to new findings that can be incorporated into the standards.

All the programs and policies described above are short-term, innovative, and flexible. If they do not work, they can be discarded; if they do work, they can be expanded and continually modified. To determine the effectiveness of these programs on the behavior of the public, a method of measurement must be devised. At least two alternatives may be used either separately or, preferably, together. At a low cost, questions can be added to regular public opinion polls conducted in California by several organizations that could be used to evaluate changes in public use of the Bay and public attitudes toward the Bay, as programs were instituted or modified. Actual recreational use of the Bay can be measured by standard counting techniques either for total use or for selected samples. Both are low-budget methods that provide direct information for evaluating the success or failure of programs.

Recreational activities likely do not constitute the total effects of perceived pollution on people, though the effects on these activities are most easily measured. At least two categories of effects are

suggested. The first category consists of those effects that are recognized by a person but not associated with perceived pollution. Only if perceived pollution were not present could the cause be identified. Another environmental problem provides a more clear example of this type of effect. High background noise may be "tuned out" by a person and he is not conscious that the noise is affecting his irritability or nervousness. However, once the sound stops or when the person moves into a different environment in which the noise is not present, he is aware that the noise was really bothering him.

In the second category are those cases in which a person can identify the cause but cannot verbalize the effects. These two issues were given only minor consideration in this study, via the question "What are the most unappealing things about the Bay?" The response of water pollution was given by a majority of the people, much more than for all recreational activities combined. However, the degree to which pollution affects the life of the person is not measured or investigated any further. This would constitute a desirable extension of the present study and the results could be as useful.

There are other facts revealed by this survey that are relevant to public policy. The fact that only half the people believe the Bay is polluted now and that 18 percent believe that it definitely is not, has important implications for financing quality control facilities and programs. Bond issues that require two-thirds majorities would seem to be in trouble from the beginning. Of course, there is no implication that they will automatically fail, because information campaigns that "sell" the program can influence many votes. Also, some persons

automatically vote for bond issues just as others automatically vote against them. Survey research could have an important role, in identifying the issues, the nature of the support and the opposition, and the probability of success, so that public agencies could more adequately answer the questions people have about the desirability of the bond issue. There is no substitute for the survey that has yet been developed. Neither the findings of a public hearing nor the conclusions of a politician with "his ear to the ground", though each has a definite, important place in the process, are generalizable to the voting public, except by chance.

The fact that such a substantial portion of the public knows little about the Bay raises a serious question about the advisability of requiring two-thirds majorities for the passage of bond issues. This is a value question that must be decided in the political arena and not in the conduct of an investigation such as this. It is an issue of great importance and the information provided by this survey is certainly relevant to the decision.

The series of questions about private conservation organizations is both interesting and of practical consequence. The conservation organizations appear to be vocalizing the deeply felt attitudes and values of the public at large, as indicated by the facts that:

- a) The conservation organizations without exception are interested in cleaner water and campaign for it;
- b) 71 percent of the respondents in this survey said they care a great deal about whether the Bay is polluted, with an additional 19 percent caring "somewhat";

- c) Only 7.6 percent of the respondents did not agree with the item: "Our streams and lakes should be clean whether or not we use them". Half of these were either undecided or did not answer the item;
- d) 30 percent of the respondents felt strongly enough about the subject to say that they would be willing to donate one day a month in the summer to help clean up beaches (whether such a large turnout would actually be experienced is, of course, another question, but the degree of emotional responses to this item indicates the depth of feeling about this environmental problem).

On the other hand, with few exceptions, persons interviewed neither belonged to nor supported these organizations. Sixteen percent of the respondents thought the Save San Francisco Bay Association had taken a public position on the Bay, and 8 percent thought the Sierra Club had taken a public position. Thus, the degree of public awareness of their activities is such that not even a majority of the population have an opinion on whether the organizations have taken a position on a local issue that they consider of great importance.

The issues of credibility and public confidence are raised by the questions "Do you think that San Francisco Bay can be cleaned up?" and "Do you think San Francisco Bay will be cleaned up?" Only 15 percent of those answering did not give an affirmative response to the first question and the negative responses emphasized technical limitations and political factors. However, half of those answering the second question gave negative responses. Political factors, social factors,

cost, and intransigent industries were cited as the principal reasons. These responses indicate a major discrepancy between the possible and the probable with the blame for the discrepancy being laid not on technology but upon our social and political institutions.

On the other hand, the credibility of public agencies and news media was uniformly high. Only the opinions of close friends were considered not credible by a majority of the respondents (yet, much of the information about Bay pollution seems to come from friends).

The news media and public agencies are seen as having the primary responsibility for disseminating information to the public about the Bay, and almost 60 percent of the respondents would like to have more information about the Bay.

It is fairly common to make projections of such things as per capita demand for recreation on the basis of demographic factors. The evidence accumulated in this survey indicates that such procedure may at times be poor, because the amount of variance explained in the dependent variable by demographic factors is low. If this is actually the case, the policy implication would seem to be that, before investing heavily in such things as economic base studies to be used in secondary analysis, planners would be well advised to consider the use of direct measurement of those variables that will actually be used in planning. The Outdoor Recreation Resources Review Commission study (1962) made a major contribution in showing the extent to which this could be done on a nationwide scale for recreation demand. The present study shows that much can be done in an even more nebulous area, effects of water pollution on people. The costs of direct measurement

may well be lower than for indirect measurement and secondary analysis. If the increased accuracy associated with direct measurement is also taken into account, the advantages are even greater.

In any case where large data collection programs are planned, it seems desirable, if not imperative, to establish relationships among predictors and dependent variables before a full-scale data collection program is undertaken. If relationships cannot be established, there is serious doubt that the data should be collected.

In doing secondary analysis, one is often forced to use composites and averages, rather than multivariate arrays for individuals. Because concomitant variation is so great among variables, the limitations of secondary inferential analysis are great. Also, attitude variables seem to be more important determinants of behavior than demographic and personal characteristics.

Gross's statement (1966), quoted above, is directly relevant to the use of quantitative data in public works planning. The most accurate data available about people are U.S. Census data: numbers, age distribution, sex distribution, etc. These data are valuable for many purposes. However, their unrestrained and unexamined use in public works planning may be quite as useless as using the estimate of cash on hand as the primary basis for corporate operations. This is not to say that measurement is worthless; quite the contrary, the usefulness of a concept is greatly enhanced if it can be measured. What should be emphasized is that it should not be simply assumed that unquantified information should not be used. First, an attempt should be made to quantify the information. If this cannot be done, then information

should be used in its unquantified form. The history of survey research shows that many kinds of data can be quantified. One almost wishes to say that if the question can be formulated, a measurement can be obtained. Such a statement is too broad, but in the realm of practical planning problems is probably not far from the truth. Survey research is not, of course, limited to the sampling of human populations though it has been widely used in such instances. It is equally applicable to the measurement of economic data, soil properties, hydrologic and geologic data, etc.

V. SUMMARY

A sample survey was conducted during September-October, 1967, in the nine-county San Francisco Bay Area to determine what effect perceived pollution of San Francisco Bay has on use of the Bay for major recreational activities and on attitudes toward the Bay. A representative cross-section of 914 adults were personally interviewed in their homes.

About half of the respondents, without prompting, cited water pollution as an unappealing feature of the Bay. Persons with annual household incomes of less than \$5,000 before taxes (20 percent of the sample respondents) and persons who refused to give their incomes (9 percent of the respondents) cited water pollution as an unappealing feature less frequently than did persons from household with incomes higher than \$5,000 per year.

Half the respondents considered the Bay polluted at the time of the survey while 32 percent didn't know or weren't sure and 18 percent did not consider the Bay polluted. These opinions were strongly influenced by the information a person had received about the Bay. In general, the more a person has heard about Bay pollution or fill, the more likely he is to consider the Bay polluted. Men were more likely to have an opinion on the subject and were more likely to consider the Bay polluted than were women. This presumably depends upon relevance of the issue to recreational habits because men participate much more than women in recreational activities on the Bay.

Many people have apprehensions about the potential harm that could be caused by contact with Bay water (27 percent of the respondents) or

by eating fish caught in the Bay (16-28 percent of the respondents). These apprehensions reflect attitudes that are strongly associated with modification of recreational use of the Bay. Persons who believe contact with Bay water could be harmful to a person or who would not eat fish caught in the Bay are much more likely to say that they do not participate in some recreational activity on the because they find some property of the water or its appearance undesirable or esthetically unappealing.

About 24 percent of the respondents gave pollution as a reason for not engaging in one or more activities on the Bay. About 20 percent said that they refrain from swimming in the Bay because of pollution. The comparable figure for water skiing is about 5 percent; for fishing, 2 percent; and for boating or sailing, about 2 percent. These responses may properly be considered adverse effects of perceived Bay pollution on the population of the Bay Area.

Men are more frequently affected by perceived pollution of the Bay than are women. The likelihood of being affected declines with age and increases with rising income, up to the \$15,000 per year level above which it declines. Persons from households that have children under 18 years of age are more likely to be affected than others. Persons employed full time are more likely to be affected than others for all activities except fishing. In the latter case, unemployed persons are more likely to be affected than are others. For all activities except swimming, the likelihood of being affected by perceived pollution increases with increasing education up to the level of some college, business, or technical school. For swimming, the likelihood of being

affected increases with increasing education through the level of college graduate.

Slightly over one percent of the respondents said that they had become ill or suffered other harmful effects from contact with Bay water. The characteristics of those persons did not differ significantly from those of the population as a whole.

The implications for policies and programs of the above findings may be summarized as follows:

1. The effects of perceived pollution on the recreational activities of Bay Area adults and, by inference, to younger persons, may appropriately be considered in the justification of public quality control programs for the Bay, to the extent that such programs could reduce the extent of the effects.
2. More attention should be given to contaminants that can be observed by use of the untrained, unaided senses, both in formal characterization of Bay water quality and in specific quality control program activities (such as continuous removal of visible debris and oil).
3. A greatly expanded program of public information about the Bay seems in order. Such a program should be factual and complete without attempting to portray it as either more or less polluted than it is. Due regard should be given to areal and temporal quality variation. Long-term as well as daily public reports are in order.
4. There is probably at most a weak, insensitive relationship between water quality as measured by conventional analytical

techniques and recreational use of a water body. The content of transferred information and attitudes toward the water body are much more important factors. The effect of changes in information content could be easily measured by using appropriate questioning in regular public opinion polls before and after information campaigns.

5. The low level of information (about one-third of the respondents say they have never heard the Bay is polluted) and the lack of consensus about Bay water quality (about one-half either don't know or say the Bay is not polluted) suggest that bond issue elections for quality control works are probably conducted in a climate of ignorance. It is clear that public agencies should inform the public about the condition of the Bay and about the programs proposed to control its quality. This function is a service to the public at the same time that it is in the interest of the agency if the agency desires public acceptance of programs to improve or maintain the quality of water in San Francisco Bay.
6. Survey research is shown to be a valuable means of enabling communication from the body politic to public agencies and legislative bodies on subjects that are of some concern to many people but not of enough importance to these persons to cause massive indignation and demonstration of concern.
7. Private conservation organizations, though their activities are little known among the general public, seem to be

voicing the widespread feelings of the general public.

8. Government agencies, scientific experts, and news media are generally considered credible sources of information about the Bay.
9. For many planning activities, it seems advisable to collect data directly on issues of interest rather than attempting to infer or estimate from other data thought to be related to the issue of interest. In cases where predictors are considered essential, the functional relationships among predictors and dependent variable(s) should be established in advance of major data collection efforts. Multivariate arrays, rather than isolated variables, composites or averages should be used wherever possible.
10. In all data collection activities, the criterion of relevance should take precedence over precision of measurement. Qualitative estimation of a relevant parameter may be of much more value than very precise measurement of a less relevant parameter.

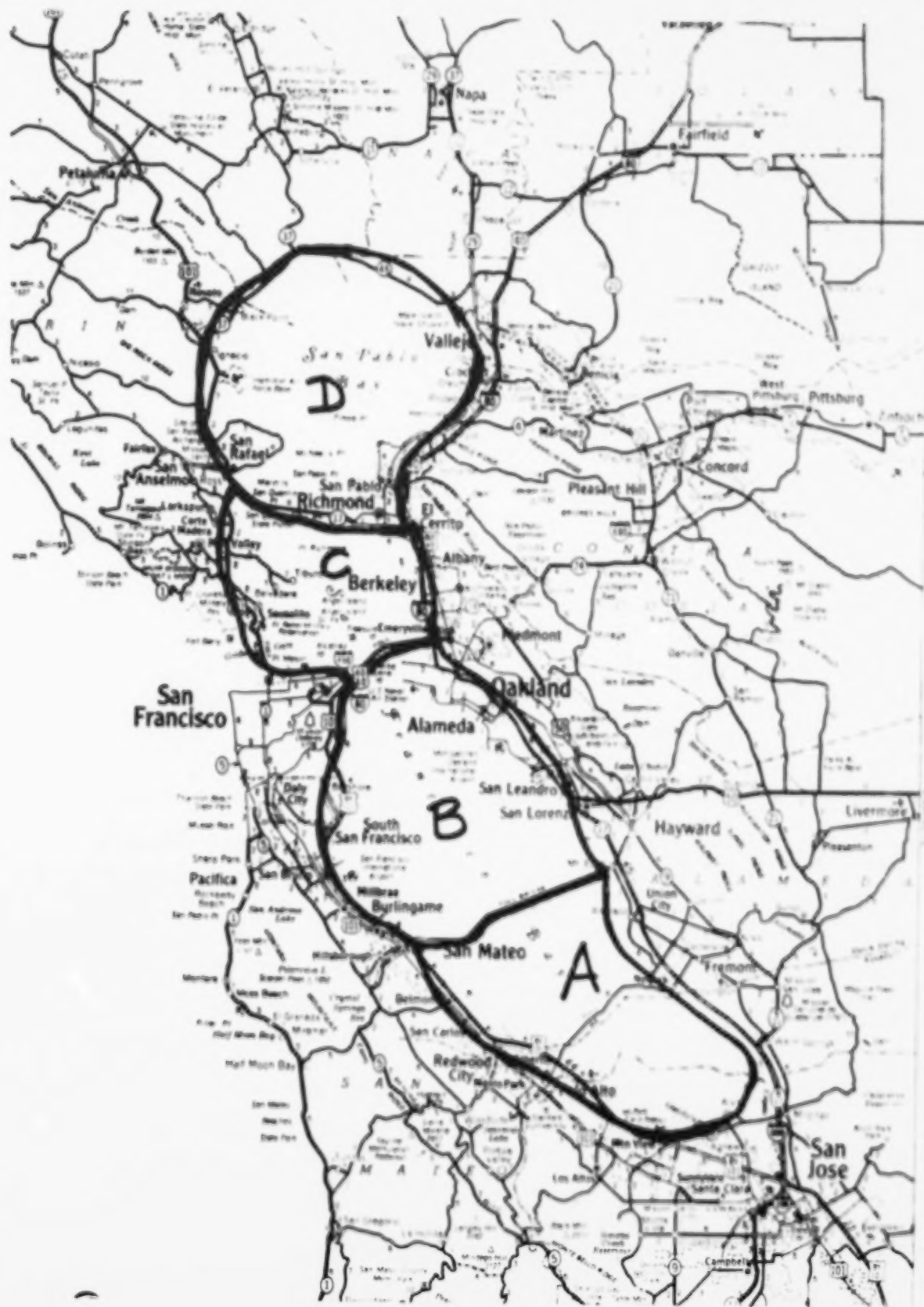
APPENDIX A. SURVEY ADMINISTRATION

This appendix consists of a report on survey administration made to the project sponsors by Survey Research Services, Inc., and the questionnaire and map used in the field. The report on survey administration is as submitted to the project sponsors, without editorial modification.

The systematic random procedure used for selecting starting points for interviewing discussed in the report consisted of the following steps:

1. The pages of residential listings for the directory were counted.
2. The number of pages was divided by the desired number of key addresses or starting points for that directory to obtain the page selection interval.
3. The starting page, a column number and a line number were selected from a table of random numbers.
4. Beginning with the starting page, the selected line in the selected column was taken on each selected page. Selected pages after the starting page were obtained by adding the page selection interval to the starting page number.
5. If the selected line contained an unsuitable address, such as a business address or an address outside the county, the next suitable residential address was taken.

The questionnaire, codebook, and a complete set of data cards have been deposited in the International Data Library and Reference Service, University of California, Berkeley, California.



SURVEY METHOD

This volume contains a description of the method followed in a survey of public opinion on San Francisco Bay water pollution. The survey was conducted for Mr. Gene Willeke of Stanford University by Survey Research Services, Inc., an affiliate of Field Research Corporation, an independent marketing and opinion research agency. Also included are copies of the questionnaire and other field materials used.

Survey Research Services was responsible for all aspects of field administration, coding and editing the completed questionnaires, and preparing a final set of statistical data cards. The questionnaire was designed jointly by SRS and Mr. Willeke.

General Approach

The survey was carried out by a face-to-face personal interview conducted in respondents' homes by skilled interviewers working under the close supervision of a senior staff member of Survey Research Services. The interview included a broad range of techniques including structured and "open-end" questions and a battery of attitude scale items.

Survey Area

The survey area was designated as the counties or portions of counties of the Bay Area which were judged to lie within approximately 30 minutes driving time from the shores of San Francisco or San Pablo Bay. Accordingly, the survey area included all of Alameda, San Francisco, San Mateo, and Solano Counties and parts of Contra Costa, Santa Clara, Marin, Napa, and Sonoma Counties.

The first step in the sample selection process was to outline the desired survey area on a detailed map of the nine-county Bay Area. Next, these rough boundaries were made to conform to appropriate census divisions for the counties so that the population of the survey area could be closely estimated from published population figures.

Next, the 1960 U.S. Census population was recorded for the designated survey area within each county and the proportion that this represented of the total county population was calculated. That percentage was then applied to the total county population estimate for 1967 as reported in the June 10, 1967 issue of Sales Management to arrive at an up-to-date estimate of the current population within the survey area of each county. The resulting figures for the survey area are shown on the following table:

Table 1.
Population Estimates for the Survey Area

	1960 population (U.S. Census)	% of total county in survey area	1967 popula- tion estimate (Sales Management)
PENINSULA			
San Francisco County	740,316	100.0	730,700
San Mateo County	444,387	100.0	537,100
Santa Clara County	642,315	-	942,700
OCD's ⁸ in survey area (Lexington; Los Altos Hills-Monte Bello; Los Gatos; Milpitas; Men. View-Los Altos; Palo Alto; San Jose; Santa Clara; Saratoga)	620,362	96.6	910,600
OCD's excluded (Coyote; Gilroy; Llagas-Uras, Morgan Hill; San Martin)	21,953	3.4	32,100
EAST BAY			
Alameda County	908,209	100.0	1,053,000
Contra Costa County	409,030	-	529,000
OCD's in survey area (all except Clayton-Tassajara)	406,767	99.3	525,300
OCD's excluded (Clayton-Tassajara)	2,263	.7	3,700

#County Census Divisions

(continued on next page)

	1960 population (U.S. Census)	% of total county in survey area	1967 popula- tion estimate (Sales Management)
<u>NORTH BAY</u>			
Marin County			
CCD's in survey area (Lucas-Gallinas Valley; Mill Valley; Northeast; Ross Valley; San Geronimo Valley; San Rafael; Sausalito; Tiburon)	146,820	-	196,000
CCD's excluded (Northwest; West)	142,830	97.3	190,700
Solano County			
CCD's excluded (Northwest; West)	3,990	2.7	5,300
Sonoma County			
CCD's in survey area (Petaluma; Petaluma rural; Santa Rosa; Santa Rosa North; Santa Rosa South; Sebastopol; Sonoma)	134,597	100.00	165,600
CCD's excluded (Cloverdale-Ceyserville; Healdsburg; Russian River-Coastal)	147,375	-	184,100
Mapa County			
CCD's in survey area (Angwin; Calistoga; Mapa; Mapa Northwest; Mapa Northeast; Mapa Southwest; Mapa West; St. Helena)	119,825	81.3	149,700
CCD's excluded (Berryessa)	27,500	18.7	34,400
	65,890	-	77,700
	65,592	99.5	77,300
CCD's excluded (Berryessa)	298	.5	400

Sample Size and Distribution

The total survey area was divided into three sub-areas -- Peninsula, East Bay and North Bay. To assure a large enough base of interviews to allow data to be analyzed separately by each of these sub-areas, a minimum number of interviews was assigned to each sub-area which did not necessarily reflect the area's population proportion. However, the distribution of interviews within each sub-area was proportionate to the population distribution of the sub-area. Statistical identifiers for each sub-area were punched into the IBM cards so that findings based on the total sample of interviews could be weighted in tabulation to reflect the actual distribution of population throughout the nine-county survey area.

A total of 914 interviews was completed and tabulated. Of these 914 interviews, 465 were conducted with women and 449 with men. The distribution of the total sample by sub-area and county is shown in Table 2.

Table 2.
Sample Distribution Within Survey Sub-Areas

	Completed Interviews		Estimated 1967 Population (Sales Management)	
	Number	%	Number	%
PENINSULA	384	100.0	2,178,400	100.0
San Francisco County (all)	134	34.9	730,700	33.5
San Mateo County (all)	90	23.4	537,100	24.7
Santa Clara County (part)	160	41.7	910,600	41.8
EAST BAY	326	100.0	1,578,300	100.0
Alameda County (all)	221	67.8	1,053,000	66.7
Contra Costa County (part)	105	32.2	525,300	33.3
NORTH BAY	204	100.0	583,300	100.0
Marin County (part)	70	34.3	190,700	32.7
Solano County (all)	60	29.4	165,600	28.4
Sonoma County (part)	50	24.5	149,700	25.7
Napa County (part)	24	11.8	77,300	13.2

Selection of Random Starting Points

Once the survey area was established, starting points for the interviewing were selected by a systematic random procedure from the latest telephone directories covering the survey area. As each random starting point (or "key address") was drawn, it was plotted on a detailed street map to be sure it fell within the designated boundaries of the survey area. If it did not, it was discarded and a substitute was drawn at random and again plotted. This procedure continued until a sufficient number of starting points and alternates were drawn to complete the total assignment.

Household Selection

Each interviewer's assignment was to complete five interviews within a cluster for which the random starting point was a "key address" selected by the method described above. The interviewer was instructed to go to the "key address" and attempt her first interview there. Regardless of whether or not she completed the interview, she was to skip the house next door and make her next attempt at the third dwelling, the next at the fifth, etc. She continued this pattern down the street, turning left at each corner so that she stayed within the block.

The interviewer was instructed to list and call on five addresses along her route in accordance with the pattern described above, and to make up to three attempts at different days and times to complete an interview at each of the five addresses before selecting an alternate address. However, alternate addresses were substituted immediately if

the interviewer encountered a refusal, an unoccupied dwelling, or a non-English speaking respondent, since these addresses would not qualify for call-backs.

If the interviewer was unable to complete five interviews in the primary block following the procedure outlined above, she was instructed to select adjacent alternate blocks in a pre-determined manner and repeat the same pattern in these blocks.

Respondent Selection

Within each cluster of five interviews per sampling location, at least two, but not more than three interviews were conducted with men. Any responsible adult member of the household at home was eligible for the interview, provided he or she met this sex quota control. It has been demonstrated in public opinion research that younger men and older women are the most difficult respondents to locate at home. Therefore, at each home contacted, the interviewer asked first to speak to the youngest man 21 or older who was at home. If no man was at home, she asked to interview the oldest woman 21 or older who was at home. Only one adult was interviewed within a single family or household.

Results of Household Contacts

Table 3 shows the results of the contacts made to obtain the 914 interviews completed and tabulated:

Table 3.
Results of Household Contacts

	Number	Percent
Total households contacted one or more times (includes call-backs)	2227	
Unoccupied dwellings	87	
Total occupied dwellings contacted	<u>2140</u>	<u>100</u>
No contact made with eligible adult (no one home, language barrier, too busy, etc.)	492	23
Refused (on any of three attempts)	660	31
Successful contact made with adult	<u>988</u>	<u>46</u>
Not eligible (didn't fit sex quota)	65	3
Discontinued interview or interview not completed enough to tabulate	9	*
Interviewed	<u>914</u>	<u>43</u>
On first attempt	601	28
On second attempt	201	9
On third attempt	112	5

*Less than 1/2 of one percent.

Interviewer Supervision

Fifty experienced members of the interviewing corps of Survey Research Services conducted the field work for this survey. All interviewers attended a group training session given by the Project Chief assigned to the study. All aspects of sampling and interviewing procedures were fully explained at this meeting, and interviewers were also given a set of detailed, written instructions to help answer any questions which might arise in the field.

After each interviewer had completed her first day's work (or not less than two interviews), she stopped interviewing and returned these completed interviews to the Interviewer Training Director who personally reviewed each one for consistency, accuracy, and understanding of all survey procedures. Each interviewer was then notified in person or by telephone of any problems discovered in her work and these were corrected before she continued with her full assignment.

Verification

Approximately 20% of each interviewer's assignment was verified by re-contacting her respondents by telephone to be sure that (a) the interview was actually made with the respondent, (b) the interviewer was polite and courteous, and (c) the interviewing procedure was carried out according to survey specifications. All interviewers' work was found to be valid and authentic.

Questionnaire Development

Several different drafts of the questionnaire were prepared and pre-tested with eligible respondents within the survey area. After each pre-test, revisions were made in question wording and certain question areas were added or deleted to arrive at a final questionnaire which would run smoothly and generate the data required by the objectives set by Mr. Willeke.

Tabulation

After all the assignments were verified, the questionnaires were edited for completeness and consistency by the coding staff and pre-

liminary answer categories were set up for coding the free-response questions. These answer categories were reviewed and approved by Mr. Willeke before any coding was undertaken.

The coded questionnaire data were then transferred to punched data cards and these cards were checked closely for accuracy and consistency on an IBM 1130 Computer with a special card cleaning program. The final set of data cards was then turned over to Mr. Willeke. This completed the project responsibility assigned to Survey Research Services.

Statistical Reliability

In any survey based on a sampling, there is some unreliability introduced into the data by the process of sampling itself. If the sample has been drawn according to strict random processes, it is possible to apply probability principles to determine the potential range of such error. However, while survey samples of human populations rarely, if ever, meet all of the criteria theoretically required for the application of these principles, it is customary to use them as an approximation of the error that is introduced as a result of sampling.

The table below shows the range of error that is associated with samples of various sizes, assuming the use of the 95% confidence level, which is customary for surveys of this type. For example, a statistic from this survey based on a group of 250 respondents is subject to a sampling variance of 4 to 6 percentage points, plus or minus. Thus, if the survey statistic shows 55% answering "yes", then we can have 95% confidence that the "true" figure would be found between 61% and 49%.

Likewise, if the statistic were 90% answering "yes", the "true" figure might be found anywhere between 86% and 94% with 95% certainty.

Table 4a.
Sampling Variability of Individual Percentages

Size of base on which percentage is computed	When the percentage in question is as follows, the chances are about 19 out of 20 (95%) that the "true"* value of the statistic would be found within plus or minus the number of per- centage points shown below for that size of base		
	When the percentage figure is:		
	About 50%	Closer to 70% or 30%	Closer to 90% or 10%
50	14	13	8.5
100	10	9	6
150	8	7.5	5
200	7	6.5	4
250	6	6	4
400	5	4.5	3
750	3.6	3.3	2.2
1000	3.2	2.9	1.9

*(The "true value" is the value that would be obtained by interviewing the total population of adults with the techniques used here.)

To determine whether two percentages are significantly different, another formula is used. Table 4b. shows the differences which must exist between two percentages derived from independent subsamples of the survey before they can be considered to indicate a real difference between the groups being compared.

Table 4b.

Levels of Significance for Differences Between Percentages

Number of cases is the smaller of the groups being compared	When two percentages are compared from different subgroups of the same survey or from different surveys, the chances are 19 out of 20 (95%) that the differ- ence between them is significant if it <u>is greater than the amounts noted below:</u>	
	Percentage points:	
50	15 - 19	
100	9 - 14	
150	8 - 11	
200	7 - 10	
400	4.5 - 7	
600	3.5 - 5.8	
800	3 - 5	
1000	2.7 - 4.2	

(The lower end of this range applies to statistics near 90% or 10%; the higher end of the range to percentages near 50%.)

In using these estimates of sampling variance, it is important to realize that sampling error is only one of the influences which may affect survey results. Other things, such as question wording, interviewer influence on respondents, etc., can cause variances in results which are often of a magnitude many times larger than any sampling errors. For this reason, the sampling error figures shown here should be used with due regard for their limitations.

Survey Dates

All interviewing was conducted between September 25 and October 20, 1967.

Survey Research Services, Inc.
145 Montgomery Street
San Francisco, Calif. 94104

BAY AREA OPINION SURVEY

y-2560
091467
Final

--	--

Time began: _____

Hello I'm _____ from Survey Research Services. We're doing a survey in this area and I'd like to get your opinions on some matters of interest to people living in the Bay Area.

1. First of all, have you always lived in the Bay Area, or did you live elsewhere before coming to the Bay Area?
- | | |
|-------------------|----------------|
| ALWAYS LIVED HERE | 1 (GO TO Q. 3) |
| LIVED ELSEWHERE | 2 (ASK Q. 2a) |

(IF "LIVED ELSEWHERE," ASK):

- 2a. Where did you live before coming to the Bay Area?
- | | |
|-----------------------|-----------------|
| OTHER U.S. STATE | 1 (GO TO Q. 2c) |
| OUTSIDE OF U.S.A. | 2 |
| OTHER NORTHERN CALIF. | 3 (ASK Q. 2b) |
| OTHER SOUTHERN CALIF. | 4 |

(IF "OUTSIDE" OR "OTHER NORTHERN" OR "SOUTHERN CALIF.," ASK):

- 2b. Have you ever lived in another part of the United States?
- | | |
|-----|---|
| YES | 1 |
| NO | 2 |

- 2c. About how long, in total, have you lived in the Bay Area?
- | | |
|---------------------|---|
| LESS THAN 1 YEAR | 1 |
| 1 YEAR - 2.9 YEARS | 2 |
| 3 YEARS - 4.9 YEARS | 3 |
| 5 YEARS - 9.9 YEARS | 4 |
| 10 YEARS OR MORE | 5 |

3. About how often do you see or look at any part of either San Francisco Bay or San Pablo Bay?
- | | |
|----------------------------|---|
| EVERY DAY | 1 |
| TWO OR THREE TIMES A WEEK | 2 |
| ABOUT ONCE A WEEK | 3 |
| 2 - 3 TIMES A MONTH | 4 |
| ABOUT ONCE A MONTH | 5 |
| LESS OFTEN THAN ONCE A MO. | 6 |

4. What are the most appealing things to you about the San Francisco Bay itself? What are the things you like about it? (PROBE) What else?

5. What are the most unappealing things about the Bay? What do you dislike about the Bay? (PROBE) What else?

6. Have you gone boating or sailing anywhere within the past year?

YES . . . 1 (ASK Q. 7 SERIES)

NO . . . X (SKIP TO Q. 8a NEXT PAGE) →

(IF "YES" TO QUES. 6, ASK):

- 7a. How many different days have you been boating or sailing within the past year?

(Total days)

- 7b. (HAND CARD A) Please look at this card and tell me all the places you've been boating or sailing within the past year. (RECORD BELOW)

- 7c. (FOR EACH PLACE MENTIONED IN QUES. 7b): On how many different days did you go boating or sailing there in the past year? (RECORD BELOW)

(Q. 7b)

PLACES WENT BOATING OR SAILING

(Q. 7c)

NO. OF DAYS WENT THERE

Anywhere on Bay 1

Lake Berryessa 2

Clear Lake 3

Lake Tahoe 4

Other Northern Calif. waters _____ (specify) _____

Other Northern Calif. waters _____ (specify) _____

Southern Calif. waters 5

Outside of Calif. waters 6

(IF "ANYWHERE ON BAY" MENTIONED IN QUES. 7b, HAND MAP TO RESPONDENT):

- 7d. Looking at this map of the Bay Area, please tell me where you usually go boating or sailing in the Bay.

ZONE A 1

ZONE B 2

ZONE C 3

ZONE D 4

(IF BAY NOT MENTIONED IN QUES. 7b, ASK):

- 7e. Is there any particular reason why you haven't gone boating or sailing on the Bay within the past year? (PROBE)

INTERVIEWER: REFER TO Q. 7c ABOVE. IF RESPONDENT BOATS OR SAILS ANYWHERE ON BAY BUT NO. OF DAYS ON THE BAY ARE LESS THAN 1/2 OF TOTAL DAYS IN Q. 7a, ASK:

- 7f. I see that you went boating or sailing on the Bay less than half the time. Is there any particular reason why you didn't go on the Bay more often? (PROBE)

(IF "NO" TO QUES. 6, ASK):

8a. Have you ever been boating or sailing on San Francisco or San Pablo Bay?

YES . . . 1 (ASK 8b)

NO . . . 2 (ASK 8c)

8b. Is there any particular reason why you haven't been boating or sailing on the Bay in the past year?

8c. Would you personally be interested in going boating or sailing on the Bay?

YES . . . 1 (ASK 8d) NO . . . 2 (ASK 8e)

8d. Is there any particular reason why you haven't been?

8e. Why is that? Any particular reason?

(NOW SKIP TO Q. 9)

(NOW SKIP TO Q. 9)

(NOW SKIP TO Q. 9)

9. Have you gone swimming anywhere except at swimming pools within the past year?

YES . . . 1 (ASK QUES. 10 SERIES)
NO . . . X (SKIP TO Q 11a NEXT PAGE) →

(IF "YES" TO Q 9, ASK):

10a. How many different days have you been swimming within the past year, not counting in swimming pools? _____
(Total days) 17.

10b. (HAND CARD A) Please look at this card and tell me all the places you've been swimming within the past year. (RECORD BELOW)

10c. (FOR EACH PLACE MENTIONED IN QUES. 10b.): On how many different days did you go swimming there in the past year? (RECORD BELOW)

(Q 10b)

PLACES WENT SWIMMING

(Q 10c)
NO. OF DAYS
WENT THERE

Anywhere on Bay 1	_____	18
Lake Berryessa 2	_____	19
Clear Lake 3	_____	20
Lake Tahoe 4	_____	
Other Northern Calif. waters _____ (specify)	_____	21
Other Northern Calif. waters _____ (specify)	_____	
Southern Calif. waters 5	_____	22
Outside of Calif. waters 6	_____	23

(IF "ANYWHERE ON BAY" MENTIONED IN QUES. 10b, HAND MAP TO RESPONDENT):

10d. Looking at this map of the Bay Area, please tell me where you usually go swimming in the Bay.

ZONE A 1
ZONE B 2
ZONE C 3
ZONE D 4

(IF BAY NOT MENTIONED IN QUES. 10b, ASK):

10e. Is there any particular reason why you haven't gone swimming in the Bay within the past year? (PROBE)

INTERVIEWER: REFER TO Q 10c ABOVE. IF RESPONDENT SWIMS ANYWHERE IN BAY, BUT NO OF DAYS IN THE BAY ARE LESS THAN 1/2 OF TOTAL DAYS IN Q 10a, ASK:

10f. I see that you went swimming in the Bay less than half the time. Is there any particular reason why you didn't go in the Bay more often? (PROBE)

(IF "NO" TO QUES. 9, ASK):

11a. Have you ever been swimming in San Francisco or San Pablo Bay?

YES . . . 1 (ASK 11b)

NO . . . 2 (ASK 11c)

11b. Is there any particular reason why you haven't been swimming in the Bay in the past year?

☐

43"

(NOW SKIP TO Q. 12)

11c. Would you personally be interested in swimming in the Bay?

YES. . . 1 (ASK 11d) NO . . . 2 (ASK 11e)

11d. Is there any particular reason why you haven't been?

☐

44"

(NOW SKIP TO Q. 12)

11e. Why is that? Any particular reason?

☐

51"

(NOW SKIP TO Q. 12)

12. Have you personally gone water skiing anywhere within the past year?

YES . . . 1 (ASK QUES. 13 SERIES)
NO . . . X (SKIP TO Q. 14a NEXT PAGE) →

(IF "YES" TO QUES. 12, ASK):

13a. How many different days have you been water skiing within the past year?

(Total days) 55

13b. (HAND CARD A) Please look at this card and tell me all the places you've been water skiing within the past year. (RECORD BELOW)

13c. (FOR EACH PLACE MENTIONED IN QUES. 13b): On how many different days did you go water skiing there in the past year? (RECORD BELOW)

(Q. 13b)

PLACES WENT WATER SKIING

(Q. 13c)
NO. OF DAYS
WENT THERE

Anywhere on Bay 1

Lake Berryessa 2

Clear Lake 3

Lake Tahoe 4

Other Northern Calif. waters _____ (specify)

Other Northern Calif. waters _____ (specify)

Southern Calif. waters 5

Outside of Calif. waters 6

(IF "ANYWHERE ON BAY" MENTIONED IN QUES. 13b, HAND MAP TO RESPONDENT):

13d. Looking at this map of the Bay Area, please tell me where you usually go water skiing on the Bay.

ZONE A 1
ZONE B 2
ZONE C 3
ZONE D 4

(IF BAY NOT MENTIONED IN QUES. 13b, ASK):

13e. Is there any particular reason why you haven't gone water skiing on the Bay within the past year? (PROBE)

INTERVIEWER: REFER TO Q. 13c ABOVE. IF RESPONDENT WATER SKIS ANYWHERE ON BAY, BUT NO. OF DAYS ON THE BAY ARE LESS THAN 1/2 OF TOTAL DAYS IN Q. 13a, ASK:

13f. I see that you went water skiing on the Bay less than half the time. Is there any particular reason why you didn't go on the Bay more often? (PROBE)

(IF "NO" TO QUES. 12, ASK):

14a. Have you ever been water skiing on San Francisco or San Pablo Bay?

YES . . . 1 (ASK Q. 14b)

NO . . . 2 (ASK Q. 14c)

14b. Is there any particular reason why you haven't been water skiing on the Bay in the past year?

☐

(NOW SKIP TO Q. 15)

14c. Would you personally be interested in water skiing on the Bay?

YES . . . 1 (ASK 14d)

NO . . . 2 (ASK 14e)

14d. Is there any particular reason why you haven't been?

☐

(NOW SKIP TO Q. 15)

14e. Why is that? Any particular reason?

☐

(NOW SKIP TO Q. 15)

15. Have you gone fishing anywhere within the past year?

YES . . . 1 (ASK QUES. 16 SERIES)

NO . . . X (SKIP TO Q. 17a NEXT PAGE) →

(IF "YES" TO QUES. 15, ASK):

16a. How many different days have you been fishing within the past year?

(Total days) 14

16b. (HAND CARD A) Please look at this card and tell me all the places you've been fishing within the past year. (RECORD BELOW)

16c. (FOR EACH PLACE MENTIONED IN QUES. 16b): On how many different days did you go fishing there in the past year? (RECORD BELOW) →

(Q. 16b)

PLACES WENT FISHING

(Q. 16c)
NO. OF DAYS
WENT THERE

Anywhere on Bay 1

15

Lake Berryessa 2

16

Clear Lake 3

17

Lake Tahoe 4

Other Northern Calif. waters

(specify)

18

Other Northern Calif. waters

(specify)

Southern Calif. waters 5

19

Outside of Calif. waters 6

20

(IF "ANYWHERE ON BAY" MENTIONED IN QUES. 16b, HAND MAP TO RESPONDENT):

16d. Looking at this map of the Bay Area, please tell me where you usually go fishing in the Bay.

ZONE A 1

ZONE B 2

ZONE C 3

ZONE D 4

(IF BAY NOT MENTIONED IN QUES. 16b, ASK):

16e. Is there any particular reason why you haven't gone fishing in the Bay within the past year? (PROBE)

INTERVIEWER: REFER TO Q. 16c ABOVE. IF RESPONDENT FISHES ANYWHERE IN BAY, BUT NO. OF DAYS IN THE BAY ARE LESS THAN 1/2 OF TOTAL DAYS IN Q. 16a, ASK:

16f. I see that you went fishing in the Bay less than half the time. Is there any particular reason why you didn't go in the Bay more often? (PROBE)

(IF "NO" TO QUES. 15, ASK):

17a. Have you ever been fishing in San Francisco or San Pablo Bay?

YES. . . 1 (ASK Q. 17b) 

NO 2 (ASK Q. 17c) 

17b. Is there any particular reason why you haven't been fishing in the Bay in the past year?

17c. Would you personally be interested in fishing in the Bay?

YES. . . 1 (ASK 17d) NO. . 2 (ASK 17e)

17d. Is there any particular reason why you haven't been?

 26- (NOW SKIP TO Q. 18)

 27- (NOW SKIP TO Q. 18)

17e. Why is that? Any particular reason?

 26- (NOW SKIP TO Q. 18)

ASK EVERYONE:

18a. Would you eat fish which were caught in the Bay?

YES 1²⁹ (SKIP TO Q. 19)
 QUALIFIED 2 } (ASK Q. 18b)
 NO 3

(IF "QUALIFIED" OR "NO" TO QUES. 18a, ASK):

18b. Why is that?

19. (HAND CARD B) Do you personally engage in any of these other recreational activities around the shoreline of the Bay? (IF YES) Which ones?

HIKING OR WALKING 1³¹
 BIRD WATCHING 2
 PICNICKING 3
 WADING 4
 SUNBATHING 5
 OTHER: _____ . 6
 (specify)
 NO, NONE OF THESE 0

20a. At the present time, do you feel that contact with Bay water could be harmful to a person in any way?

YES 1³² (ASK Q. 20b & c)
 NO 2 } (SKIP TO Q. 21a)
 DON'T KNOW, NOT SURE . 3

(IF "YES" TO QUES. 20a, ASK):

20b. In what way do you think it could be harmful? (DO NOT READ LIST. CIRCLE ANY ANSWERS MENTIONED OR WRITE IN UNDER "OTHER")

CAUSES SKIN RASH OR IRRITATION 1³³
 CAUSES NAUSEA/DIARRHEA 2
 MAKES YOU SICK (NOT SPECIFIC) 3
 OTHER (specify) _____

 DON'T KNOW, NOT SURE 0

20c. How harmful do you think it could be? Would you say it could be ... (READ CATEGORIES)

EXTREMELY HARMFUL 1³⁴
 SOMEWHAT HARMFUL 2
 ONLY SLIGHTLY HARMFUL 3

21a. To the best of your knowledge, have you personally ever become ill or suffered any harmful effects from Bay water?

YES 1³⁵ (ASK Q. 21b)
 NO 2 } (SKIP TO Q. 22a)→
 DON'T KNOW, NOT SURE . 3

(IF "YES" TO QUES. 21a, ASK):

21a. In what way? (DO NOT READ LIST. CIRCLE ANY ANSWERS MENTIONED OR WRITE IN UNDER "OTHER")

SKIN RASH OR IRRITATION 1³⁶
 NAUSEA/DIARRHEA 2
 OTHER (specify) _____

22a. Have you ever heard that San Francisco Bay is polluted?

YES 1 (ASK Q. 22b, c & d)
 NO 2 (SKIP TO Q. 23)
 DON'T KNOW, NOT SURE . . . 3

(IF "YES" TO QUES. 22a, ASK):

22b. How long ago did you <u>first</u> hear this?	WITHIN THE PAST MONTH 1 ONE - SIX MONTHS AGO 2 7 MONTHS - ONE YEAR AGO . . . 3 1.1 - 5 YEARS AGO 4 5.1 - 10 YEARS AGO 5 MORE THAN 10 YEARS AGO 6
22c. Where did you <u>first</u> hear this?	TV PROGRAM 1 RADIO 2 NEWSPAPER 3 MAGAZINE, BOOK 4 ORGANIZATION MEETING 5 FRIEND, RELATIVE 6 OTHER: _____ DON'T KNOW, NOT SURE 0
22d. Do you recall what they said caused the Bay to be polluted? (DO NOT READ LIST)	CITY SEWERS 1 INDUSTRIAL CHEMICALS AND WASTES 2 AGRICULTURAL RUN-OFF 3 GARBAGE DUMPING/BAY FILL . . . 4 BOAT WASTES 5 OTHER: _____ _____ DON'T KNOW, NOT SURE 0

23. What do you think of when someone mentions pollution of San Francisco Bay? (PROBE) What does Bay pollution suggest to you? What does that mean?

41-

24. How do you think someone could tell (would know) whether the Bay were polluted or not? What would be the signs of pollution? (PROBE) What would you look for (or expect to see?)

42-

25. How much do you personally care whether or not the San Francisco Bay is polluted? Would you say you care -- (READ LIST)

A GREAT DEAL 1
 SOMEWHAT 2
 NOT VERY MUCH 3
 HARDLY ANY 4

26a. Do you think San Francisco Bay is polluted now?

YES 44- 1 (GO TO Q. 26b)
NO 2 } (SKIP TO Q. 27a --
DON'T KNOW, NOT SURE. 0 } NEXT PAGE) →

(IF "YES" TO QUES. 26a, ASK):

26b. How polluted do you think it is?
Would you say it is . . .
(READ CATEGORIES)

EXTREMELY POLLUTED . . . 45- 1
SOMEWHAT POLLUTED . . . 2
ONLY SLIGHTLY POLLUTED . . 3

26c. What do you think causes San Francisco Bay to be polluted?
(DO NOT READ LIST)

CITY SEWERS 46- 1
INDUSTRIAL WASTES AND CHEMICALS . . . 2
AGRICULTURAL RUN-OFF 3
GARBAGE DUMPING/BAY FILL. 4
BOAT WASTES 5
OTHER _____

DON'T KNOW 0

26d. Do you think that San Francisco Bay can be cleaned up or not?

YES 47- 1 (GO TO Q. 26f)
NO 2 } (ASK Q. 26e) →
DON'T KNOW, NOT SURE. 0 }

(IF "NO" OR "DON'T KNOW", ASK):

26e. Why is that? Why not?

48-

26f. Do you think San Francisco Bay will be cleaned up?

YES 49- 1 (SKIP TO Q. 27a) →
NO 2 } (ASK Q. 26g) →
DON'T KNOW, NOT SURE. 0 }

(IF "NO" OR "DON'T KNOW", ASK):

26g. Why is that? Why not?

50-

27a. Do you remember seeing or hearing anything recently about Bay pollution or Bay fill... either on TV, the radio, or newspapers, or somewhere else?

YES 1 (GO TO Q. 27b)
NO X (SKIP TO Q. 28a)

(IF "YES" TO QUES. 27a, ASK):

27b. What did you see or hear about the Bay? (PROBE): What was it about? What was said or shown?

27c. If you wanted to find out more about this (these) issue(s), what would you do?

53/53

--	--

54.

--

28a. Have you ever attended any meetings where Bay pollution or Bay fill was discussed?

YES 1 (ASK Q. 28b)
NO X (SKIP TO Q. 29) →

(IF "YES" TO Q. 28a, ASK):

28b. What type of organization was that?

CIVIC 1
CONSERVATION 2
GOVERNMENT 3
OTHER _____
(specify)

28c. What was discussed at the meeting?

59.

--

29. Overall, how much would you say you have seen or heard about Bay pollution or Bay fill?
Would you say you have seen or heard ...
(READ CATEGORIES)
- A GREAT DEAL 1
SOMEWHAT 2
NOT VERY MUCH 3
HARDLY ANY 4
30. Do you feel that you have received as much information about Bay pollution or Bay fill as you would like to have?
- YES 1
NO 2
31. (HAND CARD C) As you see it, whose responsibility is it to see that the public gets information about the Bay?
- RADIO AND TV 1
NEWSPAPERS 2
MAGAZINES 3
CIVIC AND CONSERVATION ORGANIZATIONS 4
LOCAL GOVERNMENT 5
STATE GOVERNMENT 6
FEDERAL GOVERNMENT 7
MARINE OR WATER EXPERTS 8
OTHERS _____
32. Now suppose you were interested in finding out more about the Bay. Using this card (HAND CARD D) tell me how much you would rely on each source of information I'm going to mention. Assume that you have not formed any opinion yourself yet and you just want to know more about the matter. How much would you rely on --
- | | Very
reli-
able
source | Fairly
reli-
able
source | I'd be
cautious
of this
source | I would be
quite skep-
tical of
this source | Don't
know |
|---|---------------------------------|-----------------------------------|---|--|---------------|
| a. Official statements from the federal government | 1 | 2 | 3 | 4 | 0 |
| b. Statements by independent scientific experts | 1 | 2 | 3 | 4 | 0 |
| c. Opinions of your close friends | 1 | 2 | 3 | 4 | 0 |
| d. Newspaper editorials and articles | 1 | 2 | 3 | 4 | 0 |
| e. Official statements from the state governments | 1 | 2 | 3 | 4 | 0 |
| f. Television documentaries | 1 | 2 | 3 | 4 | 0 |
| g. Statements by private conservation organizations | 1 | 2 | 3 | 4 | 0 |
| h. Official statements from the local government | 1 | 2 | 3 | 4 | 0 |

33. (HAND CARD E) Do you belong to any of these organizations?

SIERRA CLUB 13- 1
 SAVE THE REDWOODS LEAGUE 2
 SAVE SAN FRANCISCO BAY ASSOC. 3
 THE AUDUBON SOCIETY 4
 IZAAK WALTON LEAGUE 5
 NO, NONE OF THESE 0

ANSWER FOLLOWING QUESTIONS ABOUT EACH ORGANIZATION BELONGED TO:

(Name of organization)	
a. Do you give any financial support to this organization? (IF YES) About how much money a year?	\$ _____ DO NOT GIVE ANY 0
b. Have you ever written any letters to legislators at the request of this organization?	YES 1 NO 2
c. About how often do you attend their meetings?	VERY INFREQUENTLY 1 OCCASIONALLY 2 REGULARLY 3

(Name of organization)	
a. Do you give any financial support to this organization? (IF YES) About how much money a year?	\$ _____ DO NOT GIVE ANY 0
b. Have you ever written any letters to legislators at the request of this organization?	YES 1 NO 2
c. About how often do you attend their meetings?	VERY INFREQUENTLY 1 OCCASIONALLY 2 REGULARLY 3

ASK EVERYONE

34. (REFER TO CARD E) Do you happen to know whether any of these organizations has taken a public position on (anything about) San Francisco Bay? (IF YES) Which organizations?

SIERRA CLUB 24- 1
 SAVE THE REDWOODS LEAGUE 2
 SAVE SAN FRANCISCO BAY ASSOC. 3
 THE AUDUBON SOCIETY 4
 IZAAK WALTON LEAGUE 5
 NO, NONE HAVE 9
 DON'T KNOW. 0

35. ASK FOLLOWING QUESTIONS ABOUT EACH ORGANIZATION MENTIONED IN Q 34 & FILL IN BELOW

- a. What position have they taken?
b. Do you agree or disagree with this position?

Name _____	Name _____	Name _____
a. Position:	a. Position:	a. Position:
b. AGREE STRONGLY . . . 1	b. AGREE STRONGLY . . . 1	b. AGREE STRONGLY . . . 1
AGREE SOMEWHAT . . . 2	AGREE SOMEWHAT . . . 2	AGREE SOMEWHAT . . . 2
DISAGREE SOMEWHAT . 3	DISAGREE SOMEWHAT . 3	DISAGREE SOMEWHAT . 3
DISAGREE STRONGLY . 4	DISAGREE STRONGLY . 4	DISAGREE STRONGLY . 4

36. (HAND RESPONDENT BUFF SHEET) Now, some questions on other subjects. Would you please take this sheet, read the instructions at the top, and then answer the questions as you come to them. Remember, there are no right or wrong answers, just opinions.

WHEN RESPONDENT FINISHED, TAKE BACK BUFF SHEET, RECORD INTERVIEW NUMBER ON BACK, AND ATTACH SHEET TO THIS QUESTIONNAIRE

Now, just a few final questions for classification purposes . . .

37. Would you say your own health, in general, is . . .
(READ CATEGORIES AND CIRCLE ONE)
- | |
|-------------------|
| EXCELLENT . . . 1 |
| GOOD . . . 2 |
| FAIR . . . 3 |
| POOR . . . 4 |
38. Do you have any physical handicaps that limit your recreational activities in any major way?
- | |
|-------------|
| YES . . . 1 |
| NO . . . 2 |
39. During a typical week, about how many hours do you spend on outdoor recreation of any kind? Just your best estimate.
- | |
|--------------------------------|
| NONE . . . 1 |
| LESS THAN 1 HOUR . . . 2 |
| 1 HOUR TO 1.9 HOURS . . . 3 |
| 2 HOURS TO 3.9 HOURS . . . 4 |
| 4 HOURS TO 5.9 HOURS . . . 5 |
| 6 HOURS TO 7.9 HOURS . . . 6 |
| 8 HOURS TO 9.9 HOURS . . . 7 |
| 10 HOURS TO 14.9 HOURS . . . 8 |
| 15 HOURS TO 19.9 HOURS . . . 9 |
| 20 OR MORE HOURS . . . 0 |

SPRINT

- RESPONDENT IS 1
SOMEONE ELSE IS 2

41a. What is the occupation of the chief wage earner? What type of work does (he)(she) do?

(type of work)

- (industry or service)

- | | |
|------------------------------|---|
| EMPLOYED FULL-TIME | 1 |
| EMPLOYED PART-TIME | 2 |
| NOT EMPLOYED | 0 |

- (Total in household)

- (Adults)

- (Teenagers)

- (Children 12 or under)

- | | | |
|-------------|-------|----|
| UNDER 25 | . . . | .3 |
| 25 - 34 | . . . | .2 |
| 35 - 44 | . . . | .3 |
| 45 - 54 | . . . | .4 |
| 55 - 64 | . . . | .5 |
| 65 OR OLDER | . . . | .6 |

- | | |
|--|---|
| SINGLE, NEVER MARRIED | 1 |
| SEPARATED, DIVORCED OR WIDOWED | 2 |
| MARRIED | 3 |

- | | |
|--|------|
| LESS THAN HIGH SCHOOL | 53.1 |
| SOME HIGH SCHOOL, NOT
COMPLETED | 2 |
| COMPLETED HIGH SCHOOL | 3 |
| SOME COLLEGE, BUSINESS, OR
TECHNICAL SCHOOL | 4 |
| COLLEGE GRADUATE | 5 |
| POST COLLEGE GRADUATE WORK | 6 |

- | | | | | | |
|---------------------|---------------|---|---|---|---|
| UNDER \$5,000 | . | . | . | . | 1 |
| \$5,000 - \$7,499 | . | . | . | . | 2 |
| \$7,500 - \$9,999 | . | . | . | . | 3 |
| \$10,000 - \$14,999 | . | . | . | . | 4 |
| \$15,000 - \$19,999 | . | . | . | . | 5 |
| \$20,000 - \$24,999 | . | . | . | . | 6 |
| \$25,000 OR MORE | . | . | . | . | 7 |
| | (specify amt) | | | | |
| REFUSED | . | . | . | . | X |

May I ask your name and telephone number, just so my supervisor could verify that I did this interview correctly.

Name of respondent: _____ Phone: _____

Address: _____ City: _____

INTERVIEWER: IF RESPONDENT REFUSES TELEPHONE NUMBER, PLEASE ASK
WHETHER OR NOT HE/SHE HAS A TELEPHONE AND INDICATE HERE.

HAVE TELEPHONE 1
DO NOT HAVE TELEPHONE 2

INTERVIEWER: RECORD FROM OBSERVATION ONLY

49. Type of dwelling: SINGLE-FAMILY HOUSE 1
MULTI-FAMILY HOUSE
(DUPLEX, TRIPLEX) 2
APARTMENT, FLAT 3
OTHER _____

50. Ethnic group of respondent: WHITE 1
NEGRO 2
ORIENTAL 3
OTHER _____ 4
(specify)

51. Sex of respondent: MALE 1
FEMALE 2

I certify this to be a true account of this interview: _____
(interviewer signature)

Date: _____

Time completed: _____

Census tract
for this interview

Interview Number _____

FOR OFFICE USE: _____

Verified by: _____ Date: _____

Remarks:

QUESTION 36

Please make one check mark ☒ for each statement to indicate how strongly you agree or disagree with it. If you really can't make up your mind, check the middle box for "undecided." Leave no blanks.

All the statements are matters of opinion and might be answered by different people in different ways. There are no "right" or "wrong" answers, just opinions.

Just answer each question as it comes, without spending a lot of time on any one question.

- | | <u>Strongly</u>
<u>Agree</u> | <u>Agree</u> | <u>Unde-</u>
<u>cided</u> | <u>Disagree</u> | <u>Strongly</u>
<u>Disagree</u> |
|--|---------------------------------|--------------------------|------------------------------|--------------------------|------------------------------------|
| 1. One desirable feature of regional government for the Bay Area is that it keeps the solution of problems close to home rather than in Sacramento or Washington | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2. A government agency should decide how clean the water in San Francisco Bay should be rather than local citizen groups | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3. If a city feels that the State has taken an unreasonable position, the State should be willing to compromise | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4. A developer who wants to fill part of the Bay is justified because opposing government agencies and conservationists just have an extreme point of view | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5. The details of government should be left to the experts, so that the public doesn't have to worry about them | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6. Events in the future are so uncertain that we should only be concerned with the present | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7. It's all right to keep a few redwood trees around to look at but their most important use is for lumber | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8. Technology is advancing so rapidly that we shouldn't worry about using up our natural resources | ☐ | ☐ | ☐ | ☐ | ☐ |

- | | <u>Strongly</u>
<u>Agree</u> | <u>Agree</u> | <u>Unde-</u>
<u>cided</u> | <u>Disagree</u> | <u>Strongly</u>
<u>Disagree</u> |
|--|---------------------------------|--------------------------|------------------------------|--------------------------|------------------------------------|
| 9. It doesn't pay to plan ahead more than a year or two these days because the world is changing so fast | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10. You can say all you want about beauty, but if no one will buy it, it's worthless | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11. The Bay Area is a wonderful place to live and should stay just as it is | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12. The world will probably be destroyed within the next 20 years | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13. Rather than waiting to find the one best method, pollution control administrators should take short-range action to improve the condition of the Bay | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14. We should try to solve the problems which are important to us and let our children solve theirs when their time comes | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15. We should be willing to make some sacrifices now to save our natural resources | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16. Local city councils usually aren't competent to solve complex urban problems | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17. I would be willing to donate one day a month in the summer to help clean up beaches | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18. People who don't make long-range plans are going to regret it later on | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19. Our streams and lakes should be clean whether or not we use them | ☐ | ☐ | ☐ | ☐ | ☐ |

Interviewer: _____

Interview Number: _____

APPENDIX B. DATA SUMMARY

This appendix contains the unweighted marginal percentages for the full 914 case sample. The questions have been grouped to put similar questions together, and to make a more concise summary. In many instances, percentages have been rounded to the nearest full percent. An asterisk denotes a figure less than 0.5 percent. In some cases, where multiple responses were possible, totals exceed 100 percent. In others, where multiple responses were not possible, totals may not equal 100 percent because of rounding. Additional explanatory notes are given in the text.

DEMOGRAPHIC CHARACTERISTICS

Q. 1 Have you always lived in the Bay Area, or did you live elsewhere before coming to the Bay Area?

Always lived here 29%

Lived elsewhere 71

Q. 2a If lived elsewhere in Q. 1, where did you live before coming to the Bay Area?

Other U.S. State 45% (63%)**

Southern Calif. 10 (14)

Other Northern Calif. 9 (13)

Outside of U.S.A. 7 (10)

**Percentages of those who had lived elsewhere before coming to the Bay Area.

Q. 2b If outside U.S.A. or other Northern or Southern California in Q. 2a, have you ever lived in another part of the U.S.?

Yes 11% (42%)**

No 12 (46)

No answer 3 (12)

**Percentages of those who had lived Outside U.S.A. or in other Northern or Southern California.

Q. 2c About how long, in total, have you lived in the Bay Area?

Less than 1 year	4%
1 year-2.9 years	6
3 years-4.9 years	7
5 years-9.9 years	9
10 years or more	73
No answer	1

Q. 37 Would you say your own health, in general is

Excellent	45%
Good	38
Fair	13
Poor	4
No answer	1

Q. 38 Do you have any physical handicaps that limit your recreational activities in any major way?

Yes	18%
No	80
No answer	3

Q. 40 Are you the chief wage earner for this household or is someone else?

Respondent is	62%
Someone else is	38

Q. 45 What is the last grade of school you completed?

Less than high school	12%
Some high school, not completed	14
Completed high school	30

Some college, business, or technical school	26%
College graduate	10
Post college graduate work	7
No answer	1

Q. 46 Total combined yearly household income, before taxes.

Under \$5,000	20%
\$5,000-\$7,499	18
\$7,500-\$9,999	18
\$10,000-\$14,999	23
\$15,000-\$19,999	8
\$20,000-\$24,999	2
\$25,000 or more	1
Refused	9

Q. 48 Do you have a telephone?

Have a telephone	95%
Do not have telephone	5
No answer	*

Q. 49 Type of dwelling

Single-family house	75%
Multi-family house	6
Apartment, flat	18
Other	*
No answer	1

Q. 50 Ethnic group of respondent

White	89%
-----------------	-----

Negro	4%
Oriental	3
Other	2
No answer	1

Q. 51 Sex of respondent

Male	49%
Female	51

Q. 41a What is the occupation of the chief wage earner and what industry or service does he work in?

Professional and technical	18%
Managers, officials, and proprietors	13
Clerical	8
Sales workers	6
Craftsmen, foremen, skilled manual workers	19
Operatives, semi-skilled	9
Service workers	7
Laborers	3
Student, unemployed	1
Retired, pensioner, not in labor force, widow	16
No answer	1

Q. 41c Is the chief wage earner employed at the moment--either full time or part time?

Employed full time	69%
Employed part time	4
Not employed	21
No answer	6

Q. 42 Household composition

No. of Persons	Total Persons in Household	Adults over 18	Teenagers 13-18	Children 12 or under
0	0%	0%	76%	59%
1	11	15	15	15
2	29	67	7	14
3	19	13	2	6
4	21	3	*	3
5	11	*	0	1
6	3	*	*	*
7	2	*	0	*
8	1	*	0	0
9	*	0	0	0
10	1	*	0	*
NA	*	*	*	*

Q. 43 What is your approximate age?

Under 25 11%

25-34 21

35-44 20

45-54	18%
55-64	12
65 or older	15
No answer	2

Q. 44 What is your marital status?

Single, never married	12%
Separated, divorced, or widowed	16
Married	72
No answer	*

APPEALING AND UNAPPEALING ASPECTS OF THE BAY

Q. 4 What are the most appealing things to you about the San Francisco Bay itself?

Q. 5 What are the most unappealing things to you about the San Francisco Bay itself?

	<u>Appealing</u>	<u>Unappealing</u>
Climate	9%	6%
View	72	8
Recreation opportunities	13	5
Water characteristics (other than quality)	23	10
Commercial factors	5	8
Water pollution	0	51
All other and irrelevant responses	3	4
Nothing in particular	8	28

PARTICIPATION IN RECREATION ACTIVITIES

Q. 6, 9, 12, and 15 Have you gone _____ anywhere in the past year?

	<u>Yes</u>	<u>No</u>
Boating or Sailing	27%	73%
Swimming	30	70
Water Skiing	7	93
Fishing	28	72

Q. 7, 10, 13, and 16, part a. How many days did you _____ in the past year?

<u>Activity</u>	<u>Number of Days</u>			
	1-4	5-9	10-19	20 or more
Boat or Sail . . .	16%	3%	3%	5%
Swim	11	7	6	7
Water Ski	4	1	1	1
Fish	12	6	5	5

Q. 7, 10, 13, and 16, parts b and c. How many days did you _____ on _____ in the past year?

<u>Location</u>	<u>Activity</u>	<u>Number of Days</u>			
		1-4	5-9	10-19	20 or more
S.F. Bay	Boat or Sail . . .	9%	1%	1%	2%
	Swim	2	1	1	*
	Water Ski	*	0	0	0
	Fish	6	2	1	1
L. Berryessa	Boat or Sail . . .	3	1	*	*
	Swim	3	1	*	*
	Water Ski	1	1	*	0
	Fish	1	*	1	0
Clear Lake	Boat or Sail . . .	2	1	*	*
	Swim	2	1	*	1
	Water Ski	*	*	*	*
	Fish	2	1	1	0

Location	Activity	Number of Days			
		1-4	5-9	10-19	20 or more
Other N. Calif.	Boat or Sail	9%	2%	2%	1%
	Swim	9	5	3	3
	Water Ski	2	1	*	1
	Fish	9	5	4	2
Outside N. Calif.	Boat or Sail	2	1	*	1
	Swim	3	1	2	2
	Water Ski	1	*	0	0

Q. 7, 10, 13, and 16 Percent of activity in S. F. Bay

Activity	Percent in Bay				
	None	1-24	25-49	50-74	75-100
Boating or Sailing	14% (52%)**	2% (7%)	1% (4%)	2% (7%)	8% (30%)
Swimming.	26 (87)	1 (3)	1 (3)	1 (3)	1 (3)
Water Skiing	7 (99)	0 (0)	* (1)	0 (0)	0 (0)
Fishing	18 (65)	1 (5)	1 (5)	1 (5)	6 (20)

**Percentages of those engaging in activity.

Q. 7, 10, 13, 16, part d. Where do you usually _____ on the Bay?

Activity	Zone			
	A	B	C	D
Boat or Sail.	2% (12%)**	3% (18%)	7% (41%)	5% (30%)
Swim	* (11)	1 (31)	2 (44)	1 (14)
Water Ski	0 (0)	0 (0)	0 (0)	0 (0)
Fish	1 (9)	3 (27)	4 (36)	3 (27)

**Percentages of those using the Bay for the activity.

- Q. 7, 10, 13, and 16, parts e and f; 8, 11, 14, and 17, parts b, d, and e. Reasons for curtailing or reducing recreation activity in the Bay.

Activity & Reasons	Question					Total
	E	F	B	D	E	
Boating or Sailing						
Bay Pollution	.7%	.1%	.3%	0	.5%	1.6%
Other Bay Char.	3.0	.9	.4	.4%	2.8	7.5
All Other	9.8	1.7	18.5	17.2	31.5	78.7
Swimming						
Bay Pollution	7.5	.3	1.1	1.0	10.3	20.2
Other Bay Char.	12.8	.8	2.3	1.8	18.3	36.0
All Other	10.3	.5	7.2	2.6	35.7	56.3
Water Skiing						
Bay Pollution	1.4	.1	.1	.5	3.3	5.4
Other Bay Char.	3.6	0	.1	.6	9.8	14.1
All Other	2.9	0	1.6	10.9	69.6	85.0
Fishing						
Bay Pollution	.4	.2	.4	.1	1.3	2.4
Other Bay Char.	3.3	.6	.4	.2	1.9	6.4
All Other	13.9	1.4	11.5	11.4	45.2	83.4

- Q. 8, 11, 14, and 17, part a; 8, 11, 14, and 17, part c. Have you ever been _____ in S.F. Bay? Would you be interested in _____ on the Bay?

Activity	"Have Been"		"Interested in"	
	Yes	No	Yes	No
Boating or Sailing	20%	53%	18%	35%
Swimming	9	61	5	56
Water Skiing	2	91	12	80
Fishing	13	60	12	48

- Q. 19 Do you personally engage in any of these other recreational activities around the shoreline of the Bay?

Hiking	23%
Bird Watching	4
Picnicking	22
Wading	10
Sunbathing	13
Other	5
None of these	68
No answer	*

Q. 39 During a typical week, about how many hours do you spend on outdoor recreation of any kind?

None	10%
Less than 1 hour	6
1 hour to 1.9 hours	8
2 hours to 3.9 hours	13
4 hours to 5.9 hours	13
6 hours to 7.9 hours	9
8 hours to 9.9 hours	12
10 hours to 14.9 hours.	13
15 hours to 19.9 hours.	6
20 or more hours	9
No answer	1

HEALTH ASPECTS OF SAN FRANCISCO BAY WATER QUALITY

Q. 18a Would you eat fish which were caught in the Bay?

Yes	72%
Qualified	12
No	16

Q. 18b If qualified or no to Q. 18a, why is that?

Safety aspects related to pollution	16%
Would eat only certain species	4
Don't like fish	6
Don't know, no answer	2

Q. 20a At the present time, do you feel that contact with Bay water could be harmful to a person in any way?

Yes	27%
No	45
Don't know, not sure	27
No answer	*

Q. 20b If yes to Q. 20a, in what way do you think it could be harmful?

Causes skin rash or irritation	6%
Causes nausea/diarrhea	5
Makes you sick (not specific)	17
Other	1
Don't know, not sure	2
No answer	1

Q. 20c If yes to Q. 20a, how harmful do you think it could be?

Extremely harmful	9%
Somewhat harmful	11
Only slightly harmful	6
No answer	2

Q. 21a To the best of your knowledge, have you personally ever become ill or suffered any harmful effects from Bay water?

Yes	1%
No	97
Don't know, not sure	1
No answer	1

Q. 21b If yes to Q. 21a, in what way?

Skin rash or irritation	.3%
Nausea-diarrhea	.7
Makes you sick	0
Other	.1
No answer	.3

PERCEPTION OF AND RELATIONSHIP TO SAN FRANCISCO BAY

Q. 3 About how often do you see or look at any part of either San Francisco Bay or San Pablo Bay?

Every day	24%
Two or three times a week	10
About once a week	10
2-3 times a month	12
About once a month	13
Less often than once a month	32
No answer	*

Q. 25 How much do you personally care whether or not the Bay is polluted?

A great deal	71%
Somewhat	19
Not very much	5
Hardly any	4
No answer	1

Q. 26a Do you think San Francisco Bay is polluted now?

Yes	50%
No	18
Don't know, not sure	32

Q. 26b If yes to Q. 26a, how polluted do you think it is?

Extremely polluted	12%
Somewhat polluted	27
Only slightly polluted	9
No answer	1

Q. 27a Do you remember seeing or hearing anything recently about Bay pollution or Bay fill--either on TV, radio, or newspapers, or somewhere else?

Yes	60%
No	40

CONFIDENCE IN SOCIETY AND TECHNOLOGY

Q. 26d Do you think that San Francisco Bay can be cleaned up?

Yes	42% (85%)**
No	2 (4)
Don't know, not sure	6 (12)

**Percentages of those who think Bay is polluted.

Q. 26f Do you think San Francisco Bay will be cleaned up?

Yes	25% (50%)**
No	11 (22)
Don't know, not sure	14 (28)

**Percentages of those who think Bay is polluted.

Q. 26e and 26g If not, why not?

<u>Reason</u>	<u>Can not</u>	<u>Will not</u>
Politics	1%	8%
Cost	1	7
Social factors	1	6
Intransigent industry	1	3
Time	1	2
Technical factors	2	2

PUBLIC INFORMATION AND CREDIBILITY

Q. 22a Have you ever heard that San Francisco Bay is polluted?

Yes	66%
No	29
Don't know, not sure	5

Q. 22b If yes to Q. 22a, how long ago did you first hear this?

Within the past month	3%
One-six months ago	6
7 months-one year ago	7
1.1-5 years ago	28
5.1-10 years ago	9
More than 10 years ago	13
No answer	1

Q. 22c If yes to Q. 22a, where did you first hear this?

Newspaper	30%
Friend, relative	20
TV program	14
Radio	9
Other	6
Organization meeting	2
Magazine, book	2
Don't know, not sure	5
No answer	0

Q. 23 What do you think of when someone mentions pollution of San Francisco Bay?

Causes

City, industrial, agricultural wastes, sewage, filth, detergents	37%
Fill, garbage, debris, refuse, trash, dumping	32
Social and economic factors	4

Effects

Physical and biological	40
Esthetic	26

Action orientation

Should determine cause, clean it up, do something, etc.	11
---	----

Irrelevant responses	1
--------------------------------	---

Bay is not polluted	2
-------------------------------	---

All other	*
---------------------	---

Don't know, no answer	4
---------------------------------	---

Q. 29 Overall, how much would you say you have seen or heard about Bay pollution or Bay fill?

A great deal	18%
Somewhat	31
Not very much	27
Hardly any	24
No answer	11

Q. 24 How do you think someone could tell whether the Bay were polluted or not?

Debris, garbage, dead fish, oil, foam, filth, low tide evidence	56%
Dirty, murky, scummy water, color, muddy, slimy, visual appearance	42
Odor	27
Chemical, scientific analysis	27
Mosquitoes, fewer fish, scavengers, oily fish, weedy water, fewer crabs	10
Seeing waste discharges from boats, factories, etc.	2
All others	1
Don't know, no answer	7

Q. 26c What do you think causes San Francisco Bay to be polluted?

Industrial wastes and chemicals	30% (60%)**
Garbage dumping/bay fill	30 (59)
City sewers	25 (51)
Boat Wastes	12 (23)
Agricultural run-off	5 (10)
People throw things in	2 (4)
Other	2 (3)
Don't know	2 (3)

**Percentages of persons who think the Bay is polluted or are not sure.

Q. 27b If yes to Q. 27a, what did you see or hear about the Bay?

Specific political process or debate	22% (37%)**
General political process or debate	18 (29)
Bay pollution	
General cause	4 (6)
Specific cause	8 (14)
General effect	3 (6)
Specific effect	3 (6)

Bay fill		
General cause	*	(*)
Specific cause	3%	(5%)
General effect	2	(4)
Specific effect	5	(8)
Don't know, no answer, irrelevant		
responses	6	(10)

**Percentages of persons who saw or heard something recently about the Bay.

Q. 27c If yes to Q. 27a, if you wanted to find out more about this issue, what would you do?

Specific sources		
Local politician	11%	(18%)**
Local agency	10	(17)
State agency	8	(13)
State or federal politician	5	(8)
Author or source of story	3	(5)
Federal agency	2	(4)
Friend or relative	1	(2)
Expert	1	(2)
All other specifics	3	(6)
General sources		
Newspaper	6	(10)
TV	3	(4)
Magazine	2	(3)
Radio	1	(2)
Library	3	(5)
Organizational meeting	1	(2)
Conservation organization	3	(5)
Other organization	6	(11)
All other general sources	2	(4)
Don't know, no answer	9	(15)

**Percentages of those who had heard something recently about Bay pollution or Bay fill.

Q. 30 Do you feel that you have received as much information about Bay pollution or Bay fill as you would like to have?

Yes	39%
No	58
No answer	2

Q. 31 As you see it, whose responsibility is it to see that the public gets information about the Bay?

Radio and TV	41%
Newspapers	42
Magazines	14

Civic and conservation organ.	40%
Local government	55
State government	44
Federal government	20
Marine or water experts	39
Others	2
Don't know, no answer	2

Q. 32 How much would you rely on:

	Very reli- able	Fairly reli- able	I'd be cautious	I'd be quite skeptical	No answer, don't know
a. Official state- ments of federal govern- ment	38%	38%	12%	8%	4%
b. Statements by independent scientific experts	40	35	15	5	5
c. Opinions of your close friends	3	13	37	39	8
d. Newspaper editorials and articles	10	45	28	13	4
e. Official statements of state government	39	41	11	5	4
f. TV documen- taries	24	50	16	6	4
g. Statements by private con- servation organiza- tions	21	40	22	10	7
h. Official state- ments from local govern- ment	34	40	16	5	4

ATTITUDES TOWARD GOVERNMENT, ESTHETICS, AND TIME

Question 36

	Strongly Agree	Agree	Unde- cided	Dis- agree	Strongly Disagree	No Answer
1. One desirable feature of regional government for the Bay Area is that it keeps the solution of problems close to home rather than in Sacramento or Washington	19%	46%	19%	9%	4%	2%
2. A government agency should decide how clean the water in San Francisco Bay should be rather than local citizen groups	20	33	13	26	7	2
3. If a city feels that the State has taken an unreasonable position, the State should be willing to compromise	17	51	18	10	2	2
4. A developer who wants to fill part of the Bay is justified because opposing government agencies and conservationists just have an extreme point of view	3	6	22	39	28	2
5. The details of government should be left to the experts, so that the public doesn't have to worry about them	10	18	9	40	22	2
6. Events in the future are so uncertain that we should only be concerned with the present	4	10	7	42	36	2

	Strongly Agree	Agree	Unde- cided	Dis- agree	Strongly Disagree	No Answer
7. It's all right to keep a few redwood trees around to look at but their most important use is for lumber.	4%	9%	7%	36%	42%	2%
8. Technology is advancing so rapidly that we shouldn't worry about using up our natural resources	2	7	8	35	46	2
9. It doesn't pay to plan ahead more than a year or two these days because the world is changing so fast	5	12	7	40	35	2
10. You can say all you want about beauty, but if no one will buy it, it's worthless	5	13	6	36	37	2
11. The Bay Area is a wonderful place to live and should stay just as it is	13	24	17	35	7	4
12. The world will probably be destroyed within the next 20 years	2	6	15	32	44	2
13. Rather than waiting to find the best method, pollution control administrators should take short-range action to improve the condition of the Bay	14	42	17	18	6	2
14. We should try to solve the problems which are important to us and let our children solve theirs when their time comes	4	14	7	41	31	3

	Strongly Agree	Agree	Unde- cided	Dis- agree	Strongly Disagree	Answer
15. We should be willing to make some sacrifices now to save our natural resources	35%	51%	6%	3%	3%	2%
16. Local city councils usually aren't competent to solve complex urban problems	10	31	31	22	3	2
17. I would be willing to donate one day a month in the summer to help clean up beaches	7	22	31	24	11	4
18. People who don't make long-range plans are going to regret it later on	20	48	16	12	3	2
19. Our streams and lakes should be clean whether or not we use them	51	42	2	2	2	2

APPENDIX C. DEMOGRAPHIC VALIDITY CHECKS

To check the accuracy of the sampling techniques, survey results for several of the demographic variables were compared with data from the 1960 Census for the San Jose Standard Metropolitan Statistical Area (SMSA) and the San Francisco-Oakland SMSA (Census, 1962). The comparison is shown in Appendix Table C-1. These two combined SMSA's are not identical with the study area covered by the survey but the differences are not large.

Exact checks on validity from the 1960 Census are not possible because population changes have taken place since that time. However, in those cases where changes are most likely to have taken place, the survey data probably differ in the right direction. E.g., the counties that have grown since the 1960 Census were nearly all white in 1960. If this ratio had continued, it would explain why the percentage of Negroes is lower in the survey than in the Census. The difference for other races is within limits of sampling error.

Larger differences are seen for educational level, with the survey showing higher levels of education. This is consistent with recent trends toward increasing levels of education. The same is true for income. If the 1960 median income is adjusted to 1967 levels by an index of the purchasing power of the dollar as measured by consumer prices (World Almanac, 1968, p. 871), the comparison of medians is \$8520 for the survey and \$8100 for the adjusted 1960 Census.

Age differences are all within limits of sampling error.

A larger discrepancy exists between the two sets of data for marital status, with lower percentages of single persons. No explanation

APPENDIX TABLE C-1. DEMOGRAPHIC VALIDITY CHECKS

	1960 Census	Survey	Survey Error Limits
Ethnic Group			
White	89.3%	91.0%	*1.8-2.6%
Negro	7.1	4.3	1.3-1.8
Other races	3.6	5.1	1.4-2.1
Education			
Less than high school	26.8	11.6	2.1-2.9
Some high school	18.7	14.6	2.3-3.2
High school completed	28.6	30.6	3.0-4.2
Some college, business or trade school	13.4	25.9	2.8-4.0
College graduate	12.4	17.3	2.4-3.5
Family Income			
Less than \$5,000	25.4	22.4	2.7-3.8
\$5,000-\$7,999	33.6	23.5	2.7-3.9
\$8,000-\$9,999	16.2	15.8	2.4-3.3
\$10,000-\$14,999	17.2	25.2	2.8-4.0
\$15,000-\$24,999	5.4	12.1	2.1-3.0
Greater than \$24,999	2.0	1.1	0.6-1.1
Age			
25-34	23.7	23.9	2.8-3.9
35-44	25.9	22.6	2.7-3.8
45-54	20.6	21.3	2.6-3.7
55-64	14.8	14.3	2.3-3.2
65 and over	14.9	17.8	2.5-3.5
Marital Status			
Married	64.7	72.6	2.9-4.1
Separated, widowed, or divorced	13.6	15.7	2.3-3.4
Single	21.8	11.6	2.1-2.9

Note--Error limits for survey are determined as follows:

Lower limit is the square root of pq/n .

Upper limit is the square root of $2pq/n$.

for this discrepancy is apparent.

Based on these comparisons, there appears to be no reason to conclude that the survey is markedly non-representative of the Bay Area population. The survey may even be more accurate than the Census for 1967 conditions, though no such claim is made and it is quite irrelevant to the evaluation of the survey results.

APPENDIX D. STATISTICAL TECHNIQUES

KOLMOGOROV-SMIRNOV TEST

Chi-square is the usual test applied to contingency tables. Expected table cell frequencies are taken as the row total times the column total for the cell in question divided by the number of cases in the table. Chi-square fails to provide a satisfactory test for contingency tables when the expected cell frequencies in one or more cells are too low. In dealing with nominal data, there may be no objective satisfactory way to combine cells to produce a new table that meets the usual chi-square requirements for contingency table analysis (Walker and Lev, 1953, p. 107).

One technique for circumventing this problem is to eliminate rows and columns that have low totals from the table (Funkhouser, 1967). Thus, chi-square is applied to a sub-table of the full table. This is a very useful heuristic technique. However, in some cases, even this technique fails to provide a test and, of course, it would be desirable to apply a test to all the rows and columns rather than to a subset.

Chi-square is basically a test of the equivalence of two frequency distributions, i.e., do two populations have the same frequency distributions? The Kolmogorov-Smirnov test, also a test of distribution equivalence, might be expected to apply to contingency table analysis. An empirical technique was developed to apply the test to such tables.

The population is taken as the total table. Cumulative distribution functions (cdfs) of this population are constructed by rank-ordering row and column totals, smallest to largest. Thus, the cdf of a row is constructed by re-ordering the cells in the row on the basis of

column totals. The cdf for the row is the cumulative summation of percentages beginning with the first re-ordered cell. The cdf of each row is then compared with the cdf composed of re-ordered column totals. The maximum difference between the cdf of a row and the cdf of the column totals is tested as a Kolmogorov-Smirnov statistic (Tate and Clelland, 1957, p. 131). N is taken as the row total. An identical procedure is used for each column with re-ordering being done on the basis of the row totals, and N is taken as the column total.

This procedure has a similarity to a procedure suggested by Snedecor and Cochran (1967, pp. 250-251), though they do not suggest the use of the Kolmogorov-Smirnov test. They say "When chi-square is significant, the next step is to study the nature of the departure from independence in more detail. Examination of the cells in which the contribution to chi-square is greatest, taking note of the signs of the deviations ($f-F$), furnishes clues, but these are hard to interpret because the deviations in different cells are correlated. Computation of the percentage distribution of the row classification within each column, followed by a scrutiny of the changes from column to column, may be more informative. Further chi-square tests may help. For instance, if the percentage distribution of the row classification appears the same in two columns, a chi-square test may confirm this." Their suggested comparison of row classification in two columns is almost identical to the process described above, but with a different test.

No explicit references are made in this thesis to the use of the Kolmogorov-Smirnov test as a test of significance, because the chi-

square test is used as the test of choice whenever it applies and there was no instance of a final tabulation where chi-square did not apply. The principal use of the K-S test was as a heuristic test in the screening procedure that necessarily takes place in testing hypotheses about relationships between variables.

It is noted that, in the above discussion, "test of significance" refers to a test of the hypothesis that there is no relationship between variables in the tabulation.

MULTIVARIATE TECHNIQUES

The technique of most value in the present study was multiple discriminant analysis. It was used both as a screening technique, and, in one instance, as a confirmation of the number of variables required to optimally describe a relationship and the nature of the multivariate relationship.

Multiple discriminant analysis is a technique for determining linear functions of predictors that best discriminate between two or more groups. For the two-group case, it is identical with multiple regression analysis if the dependent variable is taken as having the values 0 and 1, and these values are equivalent to a division of the population into two groups (Rulon, 1951, p. 89). In all other cases, multiple regression analysis differs from multiple discriminant analysis.

An intuitive understanding of discriminant analysis can be obtained by visualizing in n -dimensional space (n being the number of predictor or independent variables) swarms of points, each swarm

consisting of the points for one group. The location of the points is determined from the computed discriminant functions. The functions are such that the groups are maximally separated.

Cases not used in developing the discriminant functions can be located in this n-dimensional space and classified into one group by one of several decision rules. The one used in this analysis is that of assigning a case to the group for which the probability of group membership is highest (Dixon, 1967, pp. 214a-214u; Cooley and Lohnes, 1962, pp. 137-138). Other decision rules can be used; e.g., if one wishes to be more certain of correctly classifying cases into one group, at the risk of incorrectly assigning more cases of the other group, such a rule can be formulated.

Discriminant analysis of survey research data enables the maximum utilization of a powerful multivariate technique when the criterion or dependent variable is a nominal or ordinal measure. If a case can unambiguously be assigned to a group, discriminant analysis may be used to calculate the functions that best distinguish between or among the groups. If the dependent variable is an ordinal measure, there are no problems with varying intervals between scale points.

BIBLIOGRAPHY

1. Bay Conservation and Development Commission Staff, Recreation, San Francisco Bay Conservation and Development Commission, San Francisco, January, 1968, p. 9.
2. Bernard Berelson and Gary A. Steiner, Human Behavior (New York: Harcourt, Brace and World, Inc., 1964), p. 88.
3. Alex Calhoun, John E. Skinner, Harold K. Chadwick, A.B. Albrecht, and Cliffo Corson, Striped Bass Fishing Map for the Bay and Delta Areas of Central California, The Resources Agency, Department of Fish and Game, State of California, Sacramento, California, 1965.
4. U.S. Bureau of the Census, U.S. Censuses of Population and Housing: 1960, Census Tracts, Final Report PHC (1)-137, PHC (1)-138, U.S. Government Printing Office, Washington, D.C., 1962.
5. William W. Cooley and Paul R. Lohnes, Multivariate Procedures for the Behavioral Sciences (N.Y.: John Wiley and Sons, Inc., 1962), pp. 35, 137-138.
6. W.J. Dixon, Biomedical Computer Programs (Los Angeles: Univ. of California Press, 1967), pp. 214a-214u.
7. Gordon M. Fair, John C. Geyer, and Daniel A. Okun, Water and Wastewater Engineering (New York: John Wiley and Sons, Inc., 1966), p. I-1.
8. Ray Funkhouser, Four-Way Cross-Tabulation Computer Program, Unpublished, Stanford University, 1967.
9. Harold Gilliam, San Francisco Bay (Garden City, N.Y.: Doubleday and Co., Inc., 1957), pp. 83-84.

10. Bertram M. Gross, "The State of the Nation: Social Systems Accounting", Social Indicators, edited by Raymond A. Bauer (Cambridge, Massachusetts, The M.I.T. Press, 1966), pp. 166-167.
11. Oskar Morgenstern, The Accuracy of Economic Observations (Rev. ed., Princeton, N.J.: Princeton University Press, 1963), pp. 242-282.
12. Outdoor Recreation Resources Review Commission, Outdoor Recreation for America, A Report Submitted to the President and to the Congress (Washington, D.C.: U.S. Government Printing Office, 1962), pp. 1-246.
13. Public Health Activities Committee, Sanitary Engineering Division, "Coliform Standards for Recreational Waters", Journal of the Sanitary Engineering Division, American Society of Civil Engineers, v. 89, no. SA4, Proceedings Paper 3617, August, 1963, pp. 57-94.
14. P.J. Rulon, "Distinctions Between Discriminant and Regression Analysis and a Geometric Interpretation of the Discriminant Function", Harvard Educational Review, v. XXI (1951), pp. 80-90.
15. George W. Snedecor and William G. Cochran, Statistical Methods (6th ed., Ames, Iowa, Iowa State Univ. Press, 1967), pp. 250-251.
16. State Water Quality Control Board, San Francisco Bay Regional Water Quality Control Board, Water Quality Control Policy for Tidal Waters Inland From the Golden Gate Within the San Francisco Bay Region, The Resources Agency, State of California, Oakland, 1967.

17. Philip N. Storrs, Robert E. Selleck, and Erman A. Pearson, A Comprehensive Study of San Francisco Bay, 1962-1963, Third Annual Report, Sanitary Engineering Research Center, College of Engineering and School of Public Health, Univ. of California, Berkeley, SERL Report No. 64-3, April, 1964.
18. Merle W. Tate and Richard C. Clelland, Nonparametric and Shortcut Statistics (Danville, Ill.: Interstate Printers and Publishers, Inc., 1957), p. 131.
19. Helen M. Walker and Joseph Lev, Statistical Inference (N.Y.: Holt, Rinehart, and Winston, 1953), p. 107.
20. The World Almanac and Book of Facts, ed. Luman H. Long (1968 Centennial Edition, N.Y.: Newspaper Enterprise Association, Inc., 1967), p. 871.